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A SIP OF TRADITION

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ABSTRACT

One possible method of representation and conservation of values determined as Hungarikum is the cultural representation. The representation of cultural values can be realized on several levels and ways. The 'szikvíz' or soda water - the ordinary name - as a traditional Hungarian craftsman product is qualified as Hungarikum on the basis of Act XXX. of 2012. (henceforward: Act of Hungarikum) and as a registered product of *Euroterritoirs Programme* (Countries of Europe Programme) is under community protection. Beyond that it can also be categorized as a food industrial heritage. The goal of my research is the national representation of the soda water as a highlighted food industrial product, which I intend to discuss at a wider interpretational horizon, within the perspective of value declaration. The venue of the research is the 77th edition of the National Agriculture and Food Exhibition (henceforward: OMÉK), which is one of the biggest and oldest agrarian and food industrial event in Hungary with great traditions, where the Hungarikum Pavilion got place in 2015 and amongst the represented products soda water was shown. After the modification of Hungarikum Act in 2015, this was the only occasion when food procucts, which are under national protection, were presented together. With the joint application of qualitative and quantitative filters I search for the answer for the question in my article: by what kind of techniques and strategies could the national representation of soda water, which advertised the profile of 77th OMÉK, be executed and what is the importance of this?

Keywords: soda water ('szikvíz'), hungarikum, National Agriculture and Food Exhibition (OMÉK), cultural heritage, integrated heritage protection

1. INTRODUCTION

One method of social practice of value protection is the cultural representation on different levels. The interpretational framework of present essay is the examination of questions concerning the establishment, protection and representation of cultural values. I focus on the national level of cultural values, which I have already examined at individual, local, regional, national, continental and universal heritage levels. [2] Starting from the hypothesis that this heritage level from the value protection and representation point of view, submitted as protection bears with high importance regarding the agrarian és food industrial Hungarikums and also the soda water. I have chosen one of the biggest and oldest agrarian and food industrial event in Hungary with great traditions, 77th OMÉK, as venue of the representation at national level. Simultaneously, I extended the research for the regulation of value formation with legal aids as the other form of national protection. My other assumption have been formulated correlating with the previous one. According to this the building of Hungarikum is a specially Hungarian and comlpex creating procedure in 21th century.

2. MATERIAL AND METHODS

Text My aim is to show the representation techniques and strategies through the example of a traditional Hungarian product, the popular and healthy soda water by the application of the methods of on-site data collection, fieldwork, the participant observation and critical analysis in the horizon of value formation. The research is basically defined by a multiscopal approach and the parallel application of different quantitative and qualitative filters in the framework of interdisciplinary. Laws form an important common source, since they are active part of the Hungarikum creating procedure. The involvement of electronic sources into the research is also reasonable. Nowadays the preservation, protection and social utilization of the national values are becoming more and more emphasized as the answer for the states, which coalesce into international organizations on the basis of collective ideas and values in the speeding 20th century and

Analecta
REVIEW OF FACULTY OF ENGINEERING
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Vol. 10, No. 1 2016

the globalization, which is graining ground. So, every nation aims to review, document and present its own values. The Hungarian state also aims to collect, systematize and protect its values from the begining of the 21th century through Hungarikum creation. In order to understand this typical Hungarian and complex procedure, it is reasonable to start with the definition of the legal term of Hungarikum, since the registration of a Hungarikum starts on the basis of this procedure. According to point b) of 1.§ (1) article of the Act on Hungarikum the Hungarikum is a *„collective concept, which marks a value, which is worthy for distinction and highlight, which is the highest performance of the Hungarians with its caracter typical for Hungarians, unique and special, qualitative features."* [3]
The short concept definition is important because it leads to the problem of research of the values, which are registered as Hungarikum. In close correlation to this, the question arises: how does the value registration work? The identification of national values is in a pyramid, which builds up from the bottom to the top, in a multiple step system, the National Value Pyramid. On the basis of this system, every Hungarian citizen can propose the expansion of the elements of basic value collections by keeping the order. The national value can be proposed to the Hungarikum Committee among the highlighed national values, which are in the Collection of Hungarikums after admission. After a positive decision it is in the Collection of Hungarikums. According to the 12.§ (2) Article of the Act on Hungarikum the particles, which are on the UNESCO World Heritage List or at the Intangible Cultural Heritage List can be registered as Hungarikum by the special consideration of Hungarikum Committee without any proposal. The Millenary Benedictine Abbey of Pannonhalma and its natural environment, the Old village of Hollókő and its sourrundings, the Early Christian necropolis of Pécs (Sopianae) are all examples for this kind of procedure. The graphic illustration, which could also be seen at the Hungarikum Pavilion at 77th OMÉK, depicts well the procedure of the regisry of Hungarikum. (Fig. 1)

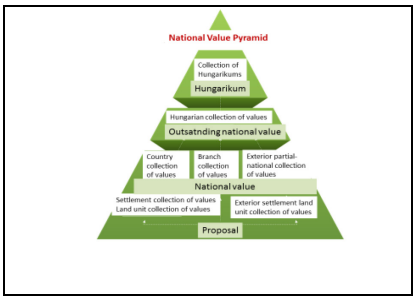

Figure 1. National Value Pyramid [4]

The previously mentioned facts help to keep track more easily with the way of demonstration of qualified value of soda water. It is worth to retrospect into the begining of the 1960s, when soda water was demonstrated as basic edible and it became fixed price product until 1977, so it was available for everybody. [5] The soda water got into the *Codex Alimentarius Hungaricus* (i.e. Hungarian Food Book) in 2004 and it also got the certification of the *Traditional Speciality Guaranteed* product (henceforth: TSG). [6] Some years later it won the usage of the trademark of *Traditions-Tastes-Regions* (hereinafter: TTR) in 2010. This kind of brand serves as a national qualification system in the field of agrarian and food factory products. By this way soda water got into the *Euroterritoirs Programme,* which main aim is to collect and protect in the whole territory of EU and on regional level also the outstanding edibles and agricultural products. [7] Then came into existence the Act of XXX. in 2012, which is on Hungarian National Values and „Hungarikums" and, which was modified multiple occasions. The act declares that the aim of the documentation and publication of our national values is not only the familiarization of the role of creation of the value and the care of the protection, but the strenghtening of the national consciousness and the national economy. [8] Under the legistlation the „Hungarikum" Committee was established in October 2012, which had 16 members then. The committee registered soda water into the Collection of

Analecta
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Hungarikums in 2013. During the procedure the elements of the product were ranked on the basis of punctual physical and chemical features. They also tried to define the enjoyment factor numerically. Important part of the regulation is the trademark of Hungarikum, which logo was born in September 2013. (Tabl. 1)

Table 1. Professional categories of the Collection of Hungarikums

Professional categories	Number of items (54)	Percentage
Cultural heritage	23	42,59%
Agriculture and Fodd Industry	19	35,19%
Health and Lifestyle	4	7,4%
Industrial and technological solutions	3	5,56%
Tourism and catering	3	5,56%
Natural environments	1	1,85%
Sport	1	1,85%
Built-up environment	0	0%

The Collection of Hungarikums consisted of 54 particles in the examined period of time, when 77th OMÉK was organized, which was expanded with further two elements till the cloze of this written material (19. June 2016) [9] I took the state of September 2015. as a basis during the analyzation and the diagram reflects this too. The 54 elements of the Collection of Hungarikums were listed into 8 partial fields, which can be seen on the diagram well. From the numbers it can be seen that actors belive that Hungarians can be prepresented through *Cultural heritage* (23 elements) and *Agriculture and Food Industry products* (19 elements). Soda water can be listed in the latter group. The values of these two categories are in absolute majority, because they are together more than ¾ (77,78%). Five professional fields represent themselves in smaller amounts: so the *Health and Lifestyle* is 4, the *Industrial and technological solutions*, the *Tourism and catering* 3-3, the *Sport* and *Natural environments* are there with 1-1 elements. The elements of the five categories together do not reach the ¼ of the total register (22,22%). If we take only the numbers into consideration, there is the danger that we pass over the importance of quantitative details. The category of *Sport* is a very good example for this. The lifework of Ferenc Puskás is presented in this category, which is one element mathematically, although the Hungarians are often identified with that. (Fig. 2)

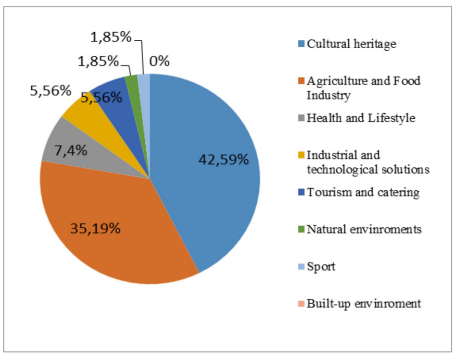

Figure 2. Professional categories of the Collection of Hungarikums

Analecta
REVIEW OF FACULTY OF ENGINEERING
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3. DESCRIPTION AND EVALUATION OF THE RESULTS

It is reasonable to take comparison between the procedures of the creation of „Hungarikum" and cultural heritage – taking the differences into consideration – because creation of „Hungarikum" – as a decent 21 th century construction - did not have a defined concept apparatus, qualification system, it needed a sample, which was found in the framework of cultural heritage. As a result, it can be seen that those actors taking part in the creation of „Hungarikum" take over and adapt the concepts, techniques, practice of the creation of heritage, which they try to fix into their image. The central question is connected to the question how does the cultural representation get on at 77th OMÉK at the Hungarikum Pavilion in the case of soda water.
The primary aim of the OMÉK 2015 was to introduce agriculture, which leans on environmentalist small and medium farms, family farms, growers, the values and result of agriculture to the public. The other intention was to aim the attention to the harmonious symbiosis of man and the environment and the consumption of products made from natural basic commodities. The framework of execution of these aims was *Natura 2000* programme, which is an ecological network established by European Union.
One of the novelties of the idea of OMÉK 2015 was the regional presentation. Through the central row, which symbolized the river Danube, all our country units got the place where they settle in reality. The visitor could theoretically walk around the routes on the *National Blue Trail* and the territories inhabited by Hungarians outside Hungary at the exhibition and fair. [10]
The Hungarian communities, who live outside the country took part at the most popular and one of the biggest agricultural and food industrial event this year. It is important for our topic because the common cultural representation of the mother country and those Hungarians, who live outside the country could be expanded. That meant the expansion and nationalization of the event of the country.
The soda water as a part of the gastronomy was represented at the exhibition and fair. Its cultural representation was executed at various levels and strategies.
The installation of the soda got place in three display cabinets, which consisted 4 shelves in the Hungarikum Pavilion. Besides the classic blue and green soda bottles, a soda filling machine was presented from which the visitors could taste the fresh soda water free of charge. The photos of Emese Lázár and Péter Rizmayer fitted into the general image well. The Hungarian National Professional Industry Committee (hereinafter: MOSZI) provided the professional background for the representation of soda water. The industry committee propagated the partial-training of the manufacturer of the product of fizzy drinks – fizzy drinks, mineral water, soda water production - too. Several topic based, propagating brochures and professional materials were part of the installation.
Among exhibitors the Sz. I. Ltd. represented the soda making manufacturers, which is lead by István Szabó, who is the head of the Industry Committee. The enterprise has been operating since 1986 in Budapest at district XI and selling soda water in traditional 1 liter, 1,5 liter plastic flasks and 25 liter stainless steel balloons. The company got the TSG and TTR trademarks, use the *Hungarian Product* ('Magyar Termék') logo and also fits for the conditions of HACCP (Hazard Analysis and Critical Control Points) international edible protection system. It is worth to mention here that according to MOSZI statistics at present almost 10 000 people work in 1500 soda water manufactures together with the background workers in Hungary. [11] All of them have GHK trademark. However very few soda water factory has HACCP certification. If we examine trademarks at national level, we can see that Hungarikum trademark is for the product, but the HACCP certification is for the manufacturer, who produce the product.
In the framework of the cross branding, the soda was not only alone, but it was represented together with other agriculture and food industry products too at the OMÉK 2015.
For example the *PICK wintersalami* and the *HERZ Classic wintersalami*, the food products from frattened goose, the *red onions from Makó*, the *ground paprika from Szeged* and *Kalocsa*, *Gyulai sausage or Gyulai double sausage*, *Csabai sausage or Csabai thick sausage* and *Tokaji aszú* etc. could be seen and purchased in the Hungarikum Pavilion. Not only food industrial and agricultural products were shown at the Hungarikum Pavilion, but other Hungarikums were presented, such as *Hungarian operetta* and *The Vizsoly*

Bible had its own stalls. The question emerged why the other values, which are not in this topic, are not presented. In my view one possible justification is that the organizers tried to present together the items, which are in the Collection of Hungarikums in a complex way, not isolated according to the integrated value protection perspectives. This fact proves the problems evolving from the categorizing of values registered as Hungarikums. While the UNESCO uses well defined concept of value in the field of heritage protection categories – world heritage, intangible cultural heritage – in elaboration and application, the creation of Hungarikums uses a more heterogeneous concept of value.

4. SUMMARY

In conclusion it can be stated that one possible way of social practice of value protection is the cultural representation at various levels. On the basis of the numbers of visitors, its traditions and popularity the more than hundred years old event, OMÉK is capable for the national representation and the effective mediation for the society of values registered as Hungarikums. With the participation of communities from Charpatian Basin, who live outside our borders, the county level representation expanded to national, mediating the hungarian national values for more people. The fact that soda water is becoming more important is proven by the role it played in the advertisement campaign of OMÉK. In this article I tried to point out that value preservation can only be effective and productive if it protects our highlighted cultural values with more complementary tools and methods. The legal background gives the basis for this, since with the procedure of registration of Hungarikum and the legistlation the first line of value preservation has been created. The 77th OMÉK helps the reservation of the qualified products, which are protected by law too. Furthermore it not only helps the survival of values, but they make profit in several fields of food industry. This was represented in the topic of soda water by submitted as protection at 77th OMÉK that it contributed to strenghtening of the role and importance of soda water, which has almost 200 years history, in everyday life.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
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COLOUR EVOLUTION OF CONVENTIONALLY AND ORGANICALLY CULTIVATED HUNGARIAN RED SPICE PAPRIKA VARIETIES

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ABSTRACT

Colour evolution of conventionally and organically cultivated Szegedi-20, Meteorit, Mihálytelki and Kármin spice paprika varieties was studied in green, break, pale red, deep red and over-ripened maturity stages. As the ripening stages forwarded the organic samples gradually lost their initial extractable colour (ASTA value) gain toward their conventional counterparts. The over-ripened colour levels were satisfactorily high in the conventional (169.9-264.8 ASTA) and in the organic (160.8-210.5 ASTA) paprika varieties as well, although the colour accumulation was 9.0-62.8 ASTA lower in the organic samples. Significant and perceptible visual colour differences (ΔE^*_{ab}) were found between the organic and conventional crops. The lightness difference (ΔL^*) indicated that the organic paprika generally were lighter than the conventional ones. The positive hue difference (ΔH^*_{ab}) showed that the colour of deep red and over-ripened organic Szegedi-20, Mihálytelki and Kármin paprika crops were more yellow compared with the conventional group. The lightness (L^*) and hue angle ($h°_{ab}$) were found the most suitable instrumental colour parameters to distinguish the ripening stages and the colour characteristics of the samples. The better colour evolution of conventional crops was attributed to the soil characteristics, nutrient supply and chemical plant protection that were specifically designed for the needs of paprika in the conventional farming.

Keywords: organic, conventional, spice paprika, colour

1. INTRODUCTION

The red spice paprika (Capsicum annuum var. longum L.) is one of the most important traditional agricultural crops of Hungary. Their processed forms such as paprika creams and spice paprika powders (milled dried pods) are widely used products in food industry and in gastronomy.
The deep red colour of spice paprika is due to the high level of carotenoids, which accumulate as a result of *de novo* (light-independent) biosynthesis during the course of ripening [1].Earlier studies demonstrated that the total carotenoid pigment content in the red spice paprika varied between 4.75-12.10 mg/g influenced by the variety, weather conditions in the growing season, crop production methods and conditions of processing technologies [1, 2, 3]. The high-performance liquid chromatography enabled the identification of red pepper pigments and more than 40 carotenoid-type compounds were found, mainly esterified with fatty acids in a form of mono and diesters [4, 5].The diesters were more stable than monoesters and unesterified carotenoids during the post harvest operations and storage, therefore their larger amounts were found to be preferred even if the total carotenoid content was relatively low [1, 2, 6]. Furthermore, these studies showed that the colour stability of spice paprika during technological process and storage is affected by the level of antioxidants such as ascorbic acid and tocopherols formed the ripening of pods.
In the industrial and commercial practice, the quality of dried and milled paprika are evaluated on the basis of total extractable colour content which is measured by photometric method and expressed as ASTA value [7].Beside the extractable colour content the visual colour plays important role in the judgment of quality and colouring power, although the relation between them is not unequivocal [8].
The instrumental surface colour measurement enables to quantify the colour differences excluding the subjective verbal sensory descriptions. A number of authors publish their data in the CIELAB (L^*, a^*, b^*) colour space system. The measure of a colour's lightness, L^*, is correctly reported without further manipulation, however a^* and b^* are merely coordinates that indirectly reflect hue and chroma but are difficult to interpret separately [9]. More importantly, these coordinates are not independent variables [10].

Analecta
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Vol. 10, No. 1 2016

Therefore, a more appropriate measure and interpretation of colour can be obtained by the calculation of hue angle ($h°_{ab}$) and Chroma (C^*_{ab}) [9].
The CIELab colour space was found to be suitable for the evaluation of colour evolution which takes place during the paprika fruit ripening [11], while other study reported that the ASTA colour values were the best measure of spice paprika quality, compared with the lightness (L*), hue angle ($h°_{ab}$) and Chroma (C^*_{ab}) colour measurements [12].
At the end of 1990's and the beginning of 2000's the organic spice paprika cultivation started in Hungary. The crops and products from organic farming represent value–added products, contribute to the active health and environment protection, maintain the biodiversity, and have a good marketability. The organic crop production uses the diseases –resistant or tolerant spice paprika varieties which were originally bred for the conventional cultivation. Reports in the scientific literature have generally been limited to the conventionally cultivated spice paprika. The objective of this research work was to study and compare the colour evolution behaviour of spice paprika varieties as a function of organic and conventional crop production methods in the 2014 growing season.

2. MATERIALS AND METHODS

2.1. Materials

Four non-pungent red spice paprika (Capsicum annuum var. longum L.) varieties were used as experimental materials: Szegedi-20, Meteorit, Mihálytelki and Kármin.
The Szegedi-20 is a widely spread variety in the Szeged spice paprika production area, but sensitive to viruses. It has 100-120mm long pendulous fruits, medium bush (400-450 mm), with thick foliage. The extractable colour content of pericarp is 240-330 ASTA after the over ripening of pods [13].
The Kármin has 100-120mm long pendulous fruits, medium bush (400-450 mm) with spreading loose foliage. The extractable colour content of over-ripened pericarp is 260-355 ASTA. [14].
The Meteorit has 100-140mm long pendulous fruits, medium bush (450-550 mm) and high yield. It is susceptible neither to virus diseases nor to bacterial leaf spots. The pods mature uniformly with the extractable colour content of 240-300 ASTA. [15].
The Mihálytelki has 100-140mm long pendulous fruits, medium bush (400-550 mm) with dark green foliage. Its pods mature early with the extractable colour content of 210-240 ASTA. Due to the adaptability, this variety provides appropriate quantity and quality of fruits in unfavourable vintage. [16].

2.2. Crop production

The conventional and organic fields were located within the traditional Szegedi spice paprika production area (Hungary).
The samples of conventional crops were obtained from the production areas of Gorzsa Agricultural Co. (Hódmezővásárhely, Hungary). The main soil type is a meadow soil, that contains 2.6% of humus, and its pH value is 7.21. The nutrient levels of soil were moderate in nitrogen (14mg/kg Nitrogen-nitrite +nitrate), good in phosphorus (188mg/kg P_2O_5), and moderate in potassium (352 mg/kg K_2O). The fertilization plan based on the MÉM-NAK instructions [17], therefore 60kg/ha of phosphorus and 92 kg/ha of potassium demands were established. The fertilisers (100% of phosphorus and potassium demand) were added to the soil during the autumn tillage. The pre-crops were winter wheat; ploughing and disc tillage soil preparation was carried out in September-October 2013, then the soil was broken up and levelled with harrow in spring of 2014. The sowing was carried out in late March- early April, with a density of 4.52-5.45 kg/ha seeds and the row spacing was 0.45m. The cultivating and mechanical weeding were carried out in June and July. For the chemical plant protection treatments Teppeki insecticide (0.14kg/ha, two occasions in June and July), Pantera 40 EC herbicide (1.5 l/ha, in July) and Cuproxat FW fungicide (2 l/ha, at the beginning of August) were used.

Analecta
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The organic paprika crops were obtained from the research production area (Balástya, Hungary) of the Rubin Spice Paprika Processing Szeged Ltd (Szeged, Hungary). The area is certified according to the organic farming legislations. The main soil type is sand, that contains 1.29% of humus, and its pH value is 7.5. The nutrient levels of soil is good in nitrogen (0.20-0.25%), phosphorus (0.20-0.25%), and in potassium (0.15-0.20%). The pre-crop was rye, which was used as green-plant manure; therefore it was broken down then ploughing into the soil at the end of March 2014. The growing of paprika seedlings (in greenhouse, April-May) was followed by the transplanting (late May) with the help of hanging reel 4-line planter machine. The adjusted row distance was 0.60 m and within the rows, the spacing between the seedlings was 0.20 m. The manual weed control was carried out at the end of June, July and August. For the chemical plant protection treatments Cuproxat FW fungicide (2.5 l/ha, in July and August) was used, which is allowed in organic farming.
The conventional and organic fields were equipped with irrigation system. However, because of the significant amount of precipitation, irrigation was not necessary. On the conventional fields 621.7 mm precipitation was registered from April to September, and 585.1 mm on the organic fields. The average precipitation of the last 5 years was 276.2 mm.

2.3. Sampling and sample preparation

The pre-harvest inspections started in the middle of August, when the paprika pods were collected in green, break, and pale red colour stages from the organic and conventional fields as well. The samples of each varieties were picked within three designated rows separately (3 repetition), where the plants showed a uniform appearance. At the pre-harvest sample collection, the pods were sorted on the basis of green, break, and pale red ripening stages (Fig. 1).
The deep red (ripened) samples were collected at the beginning of September, a few days before the industrial harvest, from the previously designated rows. Deep red coloured pods were randomly separated and over-ripened under the outdoors conditions in rasher-bags for 2.5 weeks (Fig. 1).
For the investigations the healthy, well developed and steady coloured pods were used which showed the variety-specific characteristics.
At the sample collection, the spice paprika plantations were described with regard to their appearances, development and behaviour toward plant diseases.
For the extractable and surface colour measurements 1000g of pods from each fresh and over-ripened sample were cut to 15-20 mm wide slices and dried gently in a forced air circulating oven at 50°C for 10-12 hours. The dried paprika samples were milled without the pedicels, till the entire amount of paprika powder fall through 500 µm sieve (Fig. 2).

Figure 1. Samples of conventional Mihálytelki variety in green, break, pale red, deep red and over ripen stage

Analecta
REVIEW OF FACULTY OF ENGINEERING
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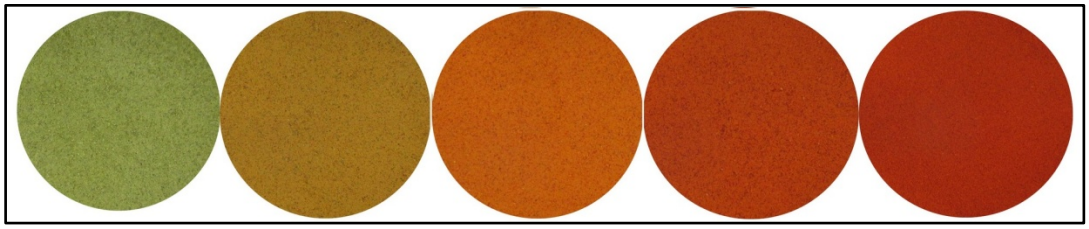

Figure 2. Dried and ground samples of conventional Mihálytelki variety in green, break, pale red, deep red and over ripen stage

2.4. Determination of extractable colour content

The extractable colour content (ASTA value) was determined according to the ASTA 20.1 method [7]. Paprika powder samples of 70-90mg were measured with 0.2mg accuracy, and transferred into 100ml volumetric flasks. The volume was then adjusted with acetone. After 4 hours a portion of the extract was transferred to the spectrophotometer cuvette and the absorbance was measured at 460 nm against an acetone blank. When the absorbance was over 0.7, the sample solution was diluted. When the absorbance was under 0.3, the weight of sample was increased. ASTA unit was calculated according to the formula:

$$ASTA = \frac{Absorbance \cdot 16{,}4 \cdot factor}{\text{the weigh of sample}\,(\text{g})} \tag{1}$$

where the Factor= 0.315/absorbance of the standard colour solution. Standard colour solution was prepared by dissolving 1.3500g cobalt-chloride and 0.0125g potassium-bi-chromate in 100 ml 5% sulphuric acid.

2.5. Surface colour measurements

The surface colour measurements of milled paprika samples was carried out with the help of WF30 colorimeter (Shenzhen Wave Optoelectronics Technology Co. Ltd., D65 light source, 8mm, CIE standard observer 10°). The instrument works according to the CIELab colour space system, therefore the colour points are characterized by the L* (lightness) a* (redness) and b* (yellowness) coordinates. Each sample was measured three times, and between the readings the samples were mixed thoroughly. The hue angle ($h°_{ab}$) and chroma (C^*_{ab}) values were calculated from each measurement data:

$$h°_{ab} = arctg\frac{b^*}{a^*} \tag{2}$$

$$C^*_{ab} = ((a^*)^2 + (b^*)^2)^{\frac{1}{2}} \tag{3}$$

The L* C* h* colour space uses cylindrical coordinates instead of rectangular coordinates (L*, a*, b*), where C^*_{ab} represents colour saturation or intensity from dull (low values) to vivid colour (high values), and $h°_{ab}$ can be defined as colour wheel with red-purple at an angle of 0, yellow at 90, bluish green at 180, and blue at 270 [9, 18, 19, 20].

The colour difference (ΔE^*_{ab}), lightness difference, (ΔL^*), saturation difference (ΔC^*_{ab}) and hue difference (ΔH^*_{ab}) were calculated in order to compare the organic and conventional varieties in each ripening stages. The colour difference (ΔE^*_{ab}) express the spatial distance between two colour points in the colour space [20]:

$$\Delta E^*_{ab} = \left[(L^*_1 - L^*_2)^2 + (a^*_1 - a^*_2)^2 + (b^*_1 - b^*_2)^2\right]^{1/2} \tag{4}$$

where, subscript 1 represents the sample (organic samples) and subscript 2 is the point of reference (conventional samples).

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Since the ΔE^*_{ab} expresses the size of colour difference but not in what way the colours of samples are different, further calculations were used [21]:

$$\Delta L^* = L_1^* - L_2^* \quad (5)$$

$$\Delta C_{ab}^* = C_{ab1}^* - C_{ab2}^* \quad (6)$$

$$\Delta H_{ab}^* = sign\left[a_2^* \cdot b_1^* - a_1^* \cdot b_2^*\right] \cdot \left[(\Delta E_{ab}^*)^2 - (\Delta L^*)^2 - (\Delta C^*)^2\right]^{1/2} \quad (7)$$

2.6. Data analysis

Microsoft Excel (Microsoft Corporation, Redmond, WA) and Statistica 8 (Statsoft Inc., Tulsa, OK) software were used for the statistical analysis. The Shapiro-Wilk test confirmed the normal distribution of measurement data ($p > 0.05$), and the Levene's test showed the homogeneity of variance ($p > 0.05$). Therefore, factorial ANOVA (with production method and paprika varieties factors) followed by Post-hoc (Fisher's test) were applied for the detailed evaluation of experimental data in each ripening stages.

2. RESULTS AND DISCUSSION

The appearances of spice paprika plants on the conventional and organic fields were characterized in the followings:
The conventional and organic Meteorit showed a similar appearance, the bush tallness was 500-680 mm, there were no signs of disease, the plants and the pods were well-developed, powerful, the foliage was lush and hugged, the bond of yields were adequate.
In the case of conventional Kármin the bush tallness was 590-680 mm, there were no signs of disease. The plants and the pods were well-developed, and the foliage was robust and hugged. The organic Kármin paprika plantation was weaker, the signs of the disease were overall (bacterial blight, powdery mildew on the leaves), and the yields from the second flowering were not retained.
The conventional and organic Mihálytelki showed a similar appearance. The bush tallness was 400-600mm, the plants and the pods were well-developed, and the foliage was rarer as compared to the Meteorit and conventional Kármin, while the bond of yields were adequate.
The conventional Szegedi-20 had a 440-570 mm bush tallness, the signs of the disease were more frequent compared with other conventional varieties (bacterial blight, powdery mildew on the leaves), but the bond of yields were adequate. On the organic field the bush tallness was similar (460-560 mm), however the plantation was weakly developed with sparse foliage, signs of the disease overall (chlorosis, bacterial blight, powdery mildew on the leaves) and the yields were not retained from the second flowering.
The frequent disease could be attributed to that the precipitation were well above the average of last 5 year (Crop production point) this condition was suitable to demonstrate the behaviour of paprika varieties in extreme weather elements.
Based on the plantation appearance, the production of Szegedi-20 and Kármin varieties were prosperous in the conventional areas with the help of chemical plant protection treatments. The Meteorit paprika, due to its resistance to disease, and the Mihálytelki, due to its tolerance properties, were successfully cultivated on the conventional and organic fields as well.
Tab. 1 shows the extractable (ASTA) colour of spice paprika varieties from the conventional and organic crop production methods in the different ripening stages. The analysis of variance resulted that the production method and the varieties factors, as well as their interaction had a significant effect ($p < 0.05$) on the variation of ASTA colour in the green, pale red and over-ripened stages. The effect of production method factor was not significant ($p > 0.05$) in the break ripening stage. The interaction of production method and the varieties factors showed no significant effect ($p > 0.05$) on the ASTA values in the deep red ripening stage.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Table 1. The extractable colour (ASTA) in the different ripening stages (average values of 3 repetitions)

Ripening stages	Szegedi-20		Meteorit		Mihálytelki		Kármin	
	conv.	organic	conv.	organic	conv.	organic	conv.	organic
Green	10.5 b[1]	13.2 b	7.6 c	11.0 b	11.3 b	22.8 a	10.5 b	14.6 b
Break	55.7 b	51.4 b	38.2 d	32.2 e	53.6 b	68.1 a	54.1 b	48.0 c
Pale red	81.9 b	108.9 a	79.6 b	104.5 a	104.9 a	81.0 b	78.7 c	84.9 b
Deep red	187.8 a	169.6 b	138.7 d	121.4 e	183.7 a	161.6 c	175.0 b	159.0 c
Over ripened	229.3 b	210.5 c	169.9 f	160.8 g	227.5 b	184.7 e	264.8 a	201.9 d

[1]The same letters indicate no significant difference ($p > 0.05$) between the samples in the same ripening stage

The climacteric ripeness starts in green fruits and proceeds through colour break stages toward the biological ripeness [1]. The ASTA values of green paprika pods (7.62-22.7 ASTA) indicated that the carotenoid biosynthesis was in early stage. The organic paprika samples had slightly higher initial extractable colour content than their conventional counterparts, due to the advantageous effect of the previous seedling and the sparser plantation density as it was described in the "Crop production" point.
During the course of ripening the extractable colour contents were increasing considerably, as a result of the accumulation of brownish-red pigments. The most remarkable changes were found between the pale red and deep red maturity stages. Ref. [1] reported that dramatic change took place in the content of mono- and diesters in the red ripe fruits and an overall 24-fold carotenoid content increase was recorded during the ripening. The organic paprika varieties gradually lost their initial ASTA colour gain toward their conventional counterparts particularly after the pale red stage. This tendency was attributed to the favourable soil characteristics of conventional field, the nutrient supply and chemical plant protection that were specifically designed in order to fulfil the physiological demand of spice paprika. The conventional Szegedi-20 and Kármin showed the highest colour value increase (105 and 92.6 ASTA respectively) followed by the conventional and organic Mihálytelki (78.7- 80.6 ASTA) and the organic Kármin (74.1 ASTA). The least colour accumulation was observed in the organic Szegedi-20 and Meteorit variety (60.6-59.0 ASTA). The great extractable colour difference between the pale and deep red pods indicated that the harvest has a crucial effect on the quality and commercial value of final spice paprika products. Therefore, traditionally the harvest is carried out in different picking periods adjusted to the different time of ripening [22].
However, the maturity stage at harvest does not mean the technological ripeness of the crop; therefore the spice paprika needs to over-ripen [1]. The carotenoid biosynthesis continues to produce more red pigments in a form of stable fatty acid mono- and diesters [1, 6].The most intensive over-ripening process was observed in the conventional Kármin variety, which showed 89.8 ASTA units increase, although its colour content was lower at the harvest period, compared with the Szegedi-20 and the Mihálytelki samples. The conventional Szegedi-20 and Mihálytelki, the organic Szegedi-20, Meteorit and Kármin showed similar colour accumulation (40.9- 43.9ASTA) during the 2.5 weeks over-ripening. The smallest increase (31.1-23.0 ASTA) was established for the conventional Meteorit and organic Mihálytelki.
As the different varieties were compared, it was clear that the organically cultivated varieties obtained significantly lower ASTA colour levels than the conventional ones. Although the Meteorit had the lowest colour content, it is a preferred variety in the spice paprika producer circles because of its resistance, high yield and uniformity at mature stage.
Table 2 shows the instrumental surface colour characteristics of spice paprika varieties from the conventional and organic fields in the different ripening stages. The colour characteristics were measured from the dried and milled (<500µm) samples of pods, because this form enabled the evaluation with regard to the paprika powder quality and decreased the errors derived from the unevenness surface of pods.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Table 2. The instrumental colour characteristics of conventional and organic samples at the different ripening stages (averages values of 3 repetitions)

	Ripening stages	Szegedi-20		Meteorit		Mihálytelki		Kármin	
		conv.	organic	conv.	organic	conv.	organic	conv.	organic
L*	Green	61.12 c[1]	60.47 c	61.77 b	62.17 b	64.77 a	60.54 c	60.28 c	59.23 d
	Break	53.59 c	54.85 b	54.27 b	56.13 a	51.59 e	53.53 c	52.38 d	52.88 d
	Pale red	53.60 a	51.39 b	51.55 b	51.71 b	51.07 c	51.99 b	51.27 c	52.28 b
	Deep red	49.25 a	49.44 a	49.76 a	49.60 a	48.25 b	48.74 b	47.12 d	49.43 a
	Over ripen	46.53 c	48.87 a	47.83 b	47.78 b	47.69 b	48.62 a	46.74 c	47.78 b
C^*_{ab}	Green	20.52 e	22.60 c	22.55 c	21.65 d	23.61 b	28.06 a	20.29 e	21.51 d
	Break	25.95 e	25.91 e	27.82 c	24.80 f	29.03 b	34.02 a	27.74 c	27.00 d
	Pale red	31.19 c	28.74 d	32.89 b	33.60 a	32.81 b	37.38 a	33.39 a	26.87 e
	Deep red	29.21 b	27.81 c	31.67 a	32.53 a	30.62 a	31.40 a	30.47 b	27.67 c
	Over ripen	28.25 c	31.54 a	30.84 b	31.36 a	30.16 b	31.48 a	31.61 a	29.81 b
$h°_{ab}$	Green	84.89 c	82.36 d	87.85 a	80.54 e	88.24 a	60.38 f	86.40 b	78.28 g
	Break	56.29 c	60.35 b	54.47 d	62.50 a	47.42 g	49.22 f	52.74 e	52.30 e
	Pale red	44.88 a	44.92 a	40.88 c	44.30 a	39.58 d	42.97 b	45.58 a	45.19 a
	Deep red	36.96 a	36.66 a	37.47 a	35.03 b	33.78 b	33.96 b	31.54 c	36.24 a
	Over ripen	28.16 d	34.65 a	30.65 b	29.47 c	31.19 b	31.58 b	28.08 d	30.12 c

[1]The same letters indicate no significant difference ($p > 0.05$) between the samples in the same ripening stage

The analysis of variance revealed that the production method, the varietal factors, and their interaction had a significant effect ($p < 0.05$) on the variation of colour parameters in the majority of ripening stages. The production method factor had no significant effect on the L* coordinates ($p > 0.05$) in the pale red stage, and on the $h°_{ab}$ values ($p > 0.05$) in the red (harvest) stage. The post hoc test indicated that the tendencies of similarities and dissimilarities between the organic and conventional varieties were not consistent in the different ripening stages.

As the ripening forwarded, the L* values decreased, indicating that the paprika samples obtained darker colour. The most remarkable changes were found between the green and break ripening stages, when the lightness values decreased with 5.62-13.8 units. In the next maturation phases the magnitude of decreasing became moderate and varied between 0.52 and 4.32 units. The dissimilarities decreased between the L* values of samples. When the pods reached the harvest-maturity (steady deep red) stage, the conventional Kármin showed the lowest L* level, this was followed by the conventional and organic Mihálytelki. There were no significant difference ($p > 0.05$) between conventional and organic Szegedi-20, Meteorit and organic Kármin samples.

The Chroma (C^*_{ab}) represents the colour saturation [18], therefore the increasing level indicated that the colour of pods became vivid during the ripening. Similarly to the L* values, the most remarkable C^*_{ab} changes were observed between the green and break stage. The conventional samples showed better C^*_{ab} increase (7.45-5.27 units) than their organic alternatives (3.15-5.96). The level of C^*_{ab} tended to slightly decrease with the advanced ripening, and the dissimilarities decreased between the samples. At the harvest (deep red stage) the conventional and organic Meteorit and Mihálytelki samples showed the most vivid colour, followed by the conventional Szegedi-20 and Kármin, while the organic Szegedi-20 and Kármin were the least saturated.

The hue angle is defined as a colour wheel, with red purple at the angle of 0° and yellow at 90° [23]. In the green pods the $h°_{ab}$ values were near to 90° indicating the low level of red pigments. The dramatic change took place between the green and break colour stages, when 28.60-40.82 units $h°_{ab}$ decrease was found in the conventional pods, while the organic ones showed lower (11.16-25.98) changes. The $h°_{ab}$ decrease became moderate during the further ripening, but showed higher changes than the L* and C^*_{ab} after the break colour stage. In harvest-maturity (deep red) stage the reddest surface colour was found in the

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

conventional Kármin, followed by the organic Meteorit and conventional Mihálytelki, while the other samples showed lower $h°_{ab}$ without significant differences.
As a result of 2.5 weeks over-ripening, the $h°_{ab}$ values showed more remarkable changes than the L* and $C*_{ab}$, indicating the accumulation of red carotenoids.

Table 3. The calculated colour difference parameters between the conventional and organic samples in the different ripening stages (averages values of 3 repetitions)

Samples	Ripening stage	$\Delta E*_{ab}$	$\Delta L*$	$\Delta C*_{ab}$	$\Delta H*_{ab}$
Szegedi-20 Conv-Org.	Green	2.424	-0.65	2.08	-0.95
	Break	2.330	1.26	-0.04	1.84
	Pale red	3.366	-2.21	-2.45	0.57
	Deep red	1.467	0.19	-1.40	-0.16
	Over ripened	5.281	2.34	3.29	3.38
Meteorit Conv-Org.	Green	3.164	0.40	-0.89	-2.82
	Break	5.192	1.86	-3.03	3.68
	Pale red	2.341	0.16	0.70	1.99
	Deep red	1.680	-0.16	0.86	-1.36
	Over ripened	1.033	-0.05	0.52	-0.64
Mihálytelki Conv-Org.	Green	13.836	-4.23	4.45	-12.39
	Break	8.640	1.94	8.35	1.03
	Pale red	2.612	0.93	1.21	1.97
	Deep red	1.339	0.69	0.77	0.49
	Over ripened	1.710	0.93	1.32	0.49
Kármin Conv-Org.	Green	3.429	-1.05	1.22	-2.96
	Break	1.145	0.50	-0.74	-0.46
	Pale red	6.607	1.01	-6.52	-0.20
	Deep red	4.414	2.31	-2.80	2.38
	Over ripened	2.367	1.04	-1.80	1.09

Tab.3 contains the calculated colour difference parameters of conventional and organic paprika sample in each ripening stages. Previous study [23] demonstrated that if the $\Delta E*_{ab} > 1.5$, then the colour difference between two paprika powders can be visually distinguished. The calculated values showed significant and perceptible visual colour differences between the organic and conventional paprika samples in the majority of ripening stages. Similarities were found merely between the over-ripened conventional and organic Meteorit, between the deep red conventional and organic Mihálytelki, and between the break conventional and organic Kármin. The lightness difference ($\Delta L*$), saturation difference ($\Delta C*_{ab}$) and hue difference ($\Delta H*_{ab}$) showed the way with which the colours of samples are different. The positive $\Delta L*$ values indicated that the paprika samples from the organic farming generally were lighter than the conventional ones. The positive $\Delta C*_{ab}$ showed that the organic Szegedi-20 and Kármin were less saturated than their conventional counterparts. However the organic Meteorit and Kármin tented to showed more vivid colour than their conventional alternatives. The positive $\Delta H*_{ab}$ values showed that the colour of organic paprika crops were closer to +b* axis, revealing that they were more yellow than the conventional ones.
When the samples represented graphically as the function of L*, $h°_{ab}$ and $C*_{ab}$ values (Fig. 3), almost complete overlapping was found between the harvest-maturity (deep red) and over-ripened stages. These tendencies indicated that, although the extractable colour content increment was significant between mature red and over-ripe products, the L*, $h°_{ab}$ and $C*_{ab}$ values were not sufficient to distinguishing the ripening stages. Fig.4 illustrates that the L*, $h°_{ab}$ and ASTA colour values were the best parameters to distinguish the ripening stages and the colour characteristics of the samples. The harvest-maturity (deep

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

red) stage of dried and milled pods were characterized with the L* values around 50 units and the $h°_{ab}$ under 40 units.

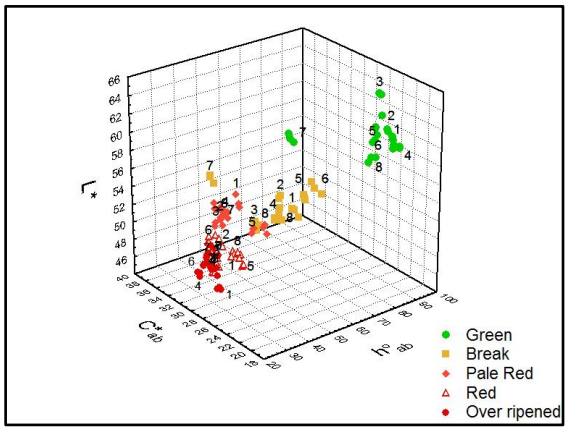

Figure 3. The positions of the samples as the function of L, $h°_{ab}$ and chroma C^*_{ab}*

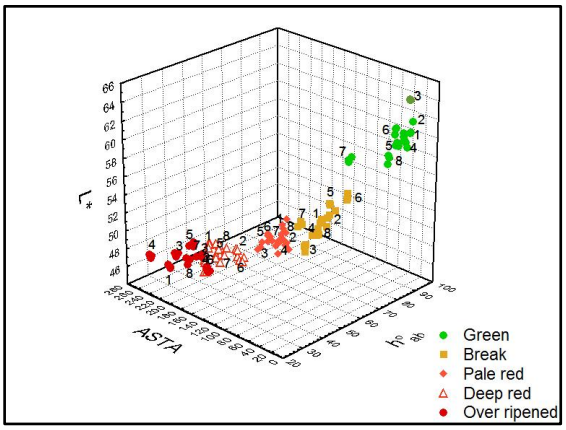

Figure 4. The positions of the samples as the function of L, $h°_{ab}$ and ASTA values*

Sample marking: 1. Conventional Szegedi-20, 2. Conventional Meteorit, 3. Conventional Mihálytelki, 4. Conventional Kármin, 5. Organic Szegedi-20, 6. Organic Meteorit, 7. Organic Mihálytelki, 8. Organic Kármin

3. CONCLUSIONS

Based on the appearance of plantations, it was concluded that the cultivation of Meteorit and Mihálytelki varieties were effective and profitable on the certified organic field according to the organic crop production principles. This was attributed to the disease resistant and tolerance properties of these varieties. All of the studied varieties were successfully cultivated on the conventional fields due to the nutrient supply and chemical plant protection that were specifically designed to fulfil the physiological demand of spice paprika.

The organic paprika samples showed lower red pigment accumulation (ASTA values) than the conventional ones. The weaker colour evolution power was confirmed by the instrumental surface colour measurement as well, since the paprika varieties from the organic fields were lighter, more yellow, and in the case of two varieties less saturated, than their conventional counterparts.

The result suggested that further experiments are necessary to establish the most suitable and optimized nutrient supply for the organic cultivation of spice paprika, which meet the requirement of the organic farming principles.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
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COMPLAINT ANALYSIS USING 8D METHOD WITHIN THE COMPANIES IN THE FIELD OF AUTOMOTIVE

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ABSTRACT

The eight disciplines (8D – Eight Disciplines of Problem Solving) model is a problem solving approach typically employed by quality engineers or other professionals and commonly used by the automotive industry. It is a meticulous process used to solve complex problems and its purpose is to identify, correct, and eliminate recurring problems, and it is useful in product and process improvement. The 8D is a method of analysis that after the detection of an irregularity, identifies and seeks the methods of solving and preventing nonconformity. It is a highly disciplined and effective scientific approach for resolving recurring problems and provides excellent guidelines to identify the root cause of the problem, implement containment actions, develop and then implement corrective actions and preventive actions that make the problem go away permanently. Therefore, the Eight Disciplines of Problem Solving (8D) is a problem-solving tool used usually in response to the removal parameters or known product specifications set by customers and incorporates all the important aspects of problem solving: problem description, root cause analysis, correcting the problem and preventing the problem. The approach establishes a permanent corrective action based on statistical analysis of the problem and focuses on the origin of the problem by determining its root causes. Although it originally comprised eight stages, or disciplines, it was later augmented by an initial planning stage. The 8D method application will result in improved products and processes is structured into eight disciplines, focusing on the synergy of the team. This is a popular method for problem solving because it is reasonably easy to teach and effective.

Keywords: nonconforming, compliance, eight disciplines, quality

1. INTRODUCTION

The 8 Discipline is a method akin to FMEA (Failure Mode and Effect Analysis). One of the essential differences between the two methods is that by 8D action is taken to remedy faults and eliminate their causes after non-compliance occurs when, through the FMEA try to anticipate their cause's defects. The 8D method is only recommended in cases with unknown cause of the occurrence of non-compliance.
Method 8 Discipline comprises the following steps, presented in Fig.1.

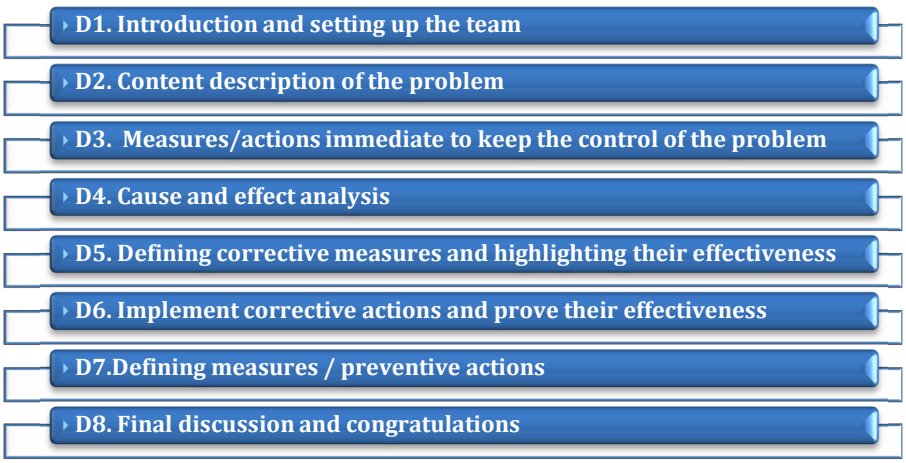

Figure 1. Method 8 Discipline steps

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
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Vol. 10, No. 1 2016

2. CASE STUDY ON APPLYING THE 8D METHOD

Next, presents a new diagram comprising the steps of applying the 8D Method, but this time the focus is on the period of time in which each stage (discipline: D1-D8; D0 signifies a stage where it is established that there was a problem; D0 is the pre-initiation process 8D).

Table 1. Step D0: Introduction

Customer number	21270357
Customer location	XXXX
Product Number	0 234 123 413
Number of complaints	196304349975
Quantity	60 / box
Complaint date	07.07.2015
Date for delivery	27.06.2015

2.1. Step D1: Introduction and setting up the team

In the first stage selection takes place team members. Nomination team members with the skills and knowledge described necessary content problem. It is generally responsible product in which the problem occurred.
The team will hold a maximum of 5 people with selecting a leader. The team should include the responsible department.

2.2. Step D2: Content description of the problem

Will perform collection of information, data, facts, figures. Description of the problem (fault/deviation) as accurately as possible, providing quantitative information (facts, figures, data, effect on Clients etc.). As actions to be taken in D2 are:
≡ collecting evidence (good / defective);
≡ gather and evaluate objective data;
≡ viewing the facts (photos, drawings, sketches)
Precise description of the fundamental problem based only on facts!
The customer received a delivery with delivery note 114643176, dated 06/27/2015 regarding this delivery for delivering customer complained, the fact that the packaging finished goods did not comply with its specifications.

Figure 2. Pack the faulty product

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

2.3. Step D3: Measures/actions immediate to keep the control of the problem

The purpose of this step is controlling the product so that non-compliance does not arise to the customer. The measures serve only as immediate protective actions and often have no connection with the causes of the problem. Develop a program/plan for implementing immediate actions to isolate the problem. Immediate action to be replaced by corrective measures defined in steps D5 and respectively in D6.

≡ causes of the problem, that immediate action was to inform all operators in the supply area to realize the mistake that could be avoided with ease;
≡ create a packaging instructions on the specific requirements of each client;
≡ creating a Poka Yoke system to prevent them from wrong packing.

This can be achieved by the computerized system used (SAP) where every customer looks for materials that must be used in packing).

2.4. Step D4: Cause and effect analysis

Determining the "*root cause*" technical and managerial: TRC (Technical Root Cause) and RCM (Root Cause Management). Apply technical questions: "*5 Why?* ".
To determine and verify and verify functional causal relationship technical root cause (TRC).
Identify root cause management (CRM) causing technical root cause. Provides an assessment of risks, including severity, likelihood and extent of this defect/noncompliance.

Table 2. Technique of the 5 questions: WHY?

Problem 1		The packaging used to wrap the finished product does not meet customer requirements. TECHNICAL ROOT CAUSE
1	WHY?	The operator responsible for wrapping, packing not complied with the instruction provided. MANAGEMENT ROOT CAUSE
2	WHY?	Operator who carried out the packing was taken to another workstation, which is why he did not know and was not clearly informed that the instructions casing.
3	WHY?	Due to the reduced staff work area was needed by other operators for packaging finished products and so deliver on time.
Problem 2		Packaging did not comply with specifications.
4	WHY?	There is a double check after packing the finished product. TECHNICAL ROOT CAUSE / MANAGEMENT ROOT CAUSE
5	WHY?	This failure was not taken into account.

Risk assessment:

≡ there is no risk that the final product delivered to affected or destroyed.
≡ this issue relates only to the packaging, not the product.

2.5. Step D5: Defining corrective measures and highlighting their effectiveness

Identification and assessment of corrective measures "optimal" addressing the root causes of technical and managerial identified.
Define potential remedial measures to eliminate the root causes (occurrence and detection).

2.6. Step D6: Implement corrective actions and prove their effectiveness

Implementation of the plan / program implementation of corrective measures aimed at removing technical and managerial causes identified.
After validating the effectiveness of their implementation and ensure that there are no side effects/negative correlated, i.e. monitoring process both internally and to the customer.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

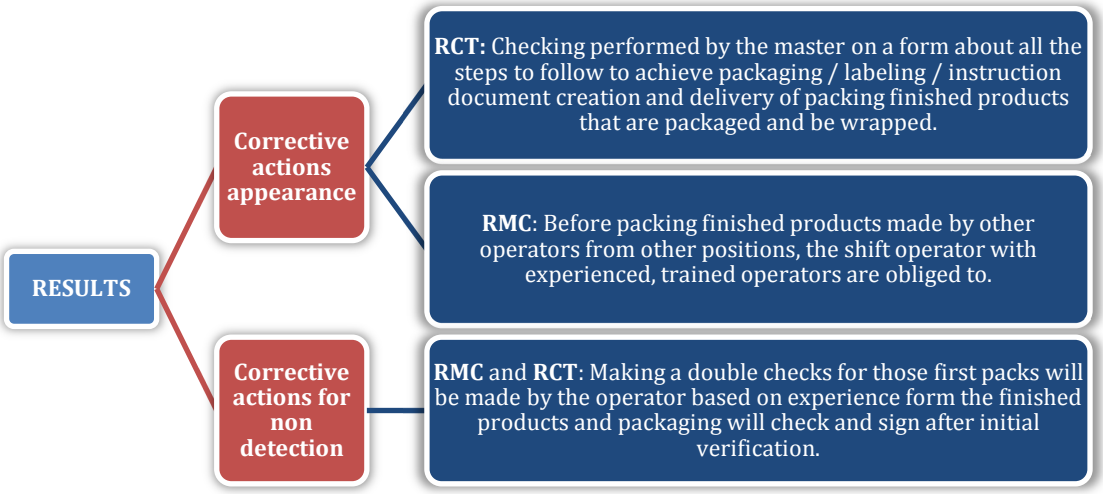

Figure 3. The corrective actions

2.7. Step D7: Defining measures / preventive actions

Identifying preventive actions to avoid problems / defects in the similar processes of production / logistics. Will ensure that there will be no risk of recurrence by updating the monitoring system of all processes and work instructions affected. (Eg FMEA, control plan, drawing, work instructions, training).

Figure 4. Measures / preventive actions

2.8. Step D8: Final discussion and congratulations

The 8D team pursuit final meeting. It will conduct a critical evaluation of the actions implemented and 8D report. 8D report will close. 8D recognition and greeting their team's efforts.
The 8D report will archive with additional documents. 07/30/2015 final session.
The causes have been identified, measures and action were defined and efficiency actions will be monitored for six weeks.

3. CONCLUSIONS

The purpose of instruction on creating packaging for finished products on the production line will lead to a decrease in time packing and especially timely delivery of products to the end customer.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Instruction working on packing the finished products is performed by the logistics department, and if deviations occur (change packaging of certain products) production will get the support of logistics.
This improvement was monitored for 12 weeks to see if it is effective measure.
Mini flow on the finished product packaging (Fig. 5) connected directly on the production line.

Figure 5. Mini packaging process flow

In the table below are data on the monitoring of 14 weeks.

Table 3. Monitoring the packaging process

Date	03-14.08	17-28.08	31.08-11.09	14-25.09	28.09-09.10	12-23.10	26.10-06.11
Total package	1.454.540	359.661	150.592	1.724.303	761.814	730.920	904.340
Customer packaging	445.289	167.678	71.234	883.601	480.288	468.108	599.890
Percentage	30.61%	46.62%	47.30%	51.24%	63.05%	64.04%	66.33%

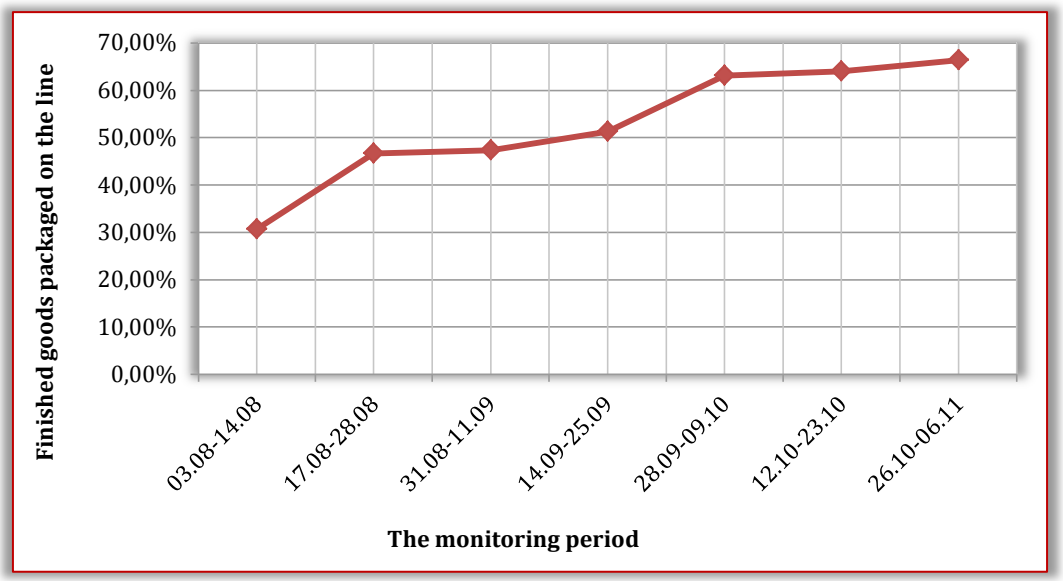

Figure 6. The monitoring graph

The factory complies with ISO / TS 16949, which is accredited by TUV SUD Romania. The purpose of this standard is to develop a quality management system to generate continuous improvement, emphasizing

defect prevention activities, reducing variation and waste minimization in the supply chain of the auto industry.

Improving implemented and presented in this paper was implemented in the company. After the analysis in this paper on quality assurance in the logistics department of the factory, it ensures the production of sensors quality, preventing the defects, if any of these defects are ways to improve in order to avoid recurrence of such defects using quality tools (Poka Yoke analysis Failure Mode and Effects (FMEA) etc.).

The 8D method application will result in improved products and processes is structured into eight disciplines, focusing on the synergy of the team. This is a popular method for problem solving because it is reasonably easy to teach and effective. Therefore, the Eight Disciplines of Problem Solving (8D) is a problem-solving tool used usually in response to the removal parameters or known product specifications set by customers and incorporates all the important aspects of problem solving: problem description, root cause analysis, correcting the problem and preventing the problem. The approach establishes a permanent corrective action based on statistical analysis of the problem and focuses on the origin of the problem by determining its root causes. Although it originally comprised eight stages, or disciplines, it was later augmented by an initial planning stage.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
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Vol. 10, No. 1 2016

DESIGN AND IMPLEMENTATION OF A DISTRIBUTED SOFTWARE ARCHITECTURE FOR DATA ACQUISTION SYSTEMS

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ABSTRACT

This paper will demonstrate the advantages of using a distributed software design for collecting environmental data. The design part will focus on achieving modularity through message queuing technologies. The essential components of the software implementation will be detailed. Finally, the testing results will be disclosed.

Keywords: data acquisition, message queuing, ZeroMQ, modular software architecture, inter-process communication

1. INTRODUCTION

The focus will be on the design of a software structure intended to use for transferring measured data between data collection systems and data acquisition devices. The main directive was to create a highly scalable and easily customable framework, including an encryption mechanism to grant security for data transfers. After reviewing literature [1], [2], [3] and [4] the following statement is true: two common software architecture styles are in use these days, layered and modular architecture. Layered design is driven by classifying solutions based on technical function, causing layers of increasing size to build on each other – this can be modelled with an inverted pyramid. In counterpart, using modularity in software design implements the theory "divide and conquer" by breaking a problem down to smaller, manageable, and in most cases independent modules. The choice was made on modular design, since it is particularly suitable for creating scalable architectures, and achieving high-availability trough redundancy.

2. MODULAR SOFTWARE DESIGN

Remote clients can be embedded systems or computers running POSIX compliant operating systems. To extend connectivity, remote devices can be used as a gateway to other not natively supported devices implementing standard digital communication interfaces, like RS-232, RS-485, CAN bus, IO-Link and more.

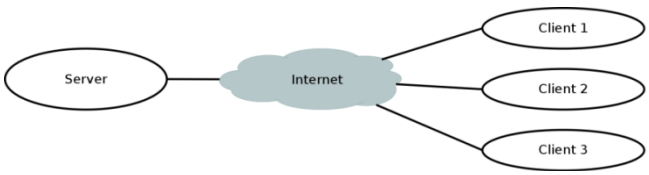

Figure 1. Main architecture topology

In the developed application the TCP layer was used as shown on Fig. 1. The Client ellipses are the remote sensor devices. The server application processes and stores the data received, Fig. 2 is intended to summarize the server-side operations. In details, the following tasks are done by the server application:

a) Listening on a TCP socket for receiving messages from the clients. The server's socket is intended to be available from Internet side, since it is likely that the remote devices have limited network connectivity because of the use of NAT or firewall. By keeping the server's socket open, the clients can initiate the connection, and send their requests. The server will send its reply on the established TCP connection.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

b) Encryption and decryption of the messages. Since the socket is unprotected, data encryption is essential to keep low the likelihood of making successful hacker attacks. Elliptic curve cryptography was chosen as encryption method, because of its robustness and efficiency [5].
c) Running validation algorithms to avoid the further processing of invalid data segments.
d) Connection to a Data Base Management System (DBMS), to store the received measurement data. The two main concepts, SQL and NoSQL DBMS systems were compared in the context of the current application, and the decision was made on PostgreSQL, but the possibility was kept open to implement a database connection module for a desired DBMS, without the need of changing, or refactoring the non-database related modules. Supporting NoSQL based approaches can have also many advantages, especially, when handling a greater amount of remote devices, or using higher sampling frequency.
e) Notification service, to inform administrators or users about operation states, and error cases. E-mail and SMS messages are currently supported.

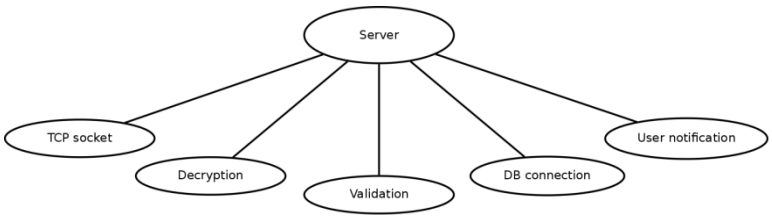

Figure 2. Server-side operations

Client side operations include the following:

a) Data acquisition. Different types of interfaces are supported, including ampere and voltage level measurements, RS-232 point-to-point communication, MODBUS protocol on RS-485/422 bus, Dallas 1-Wire bus-system and the list can be further expanded, by implementing further modules.
b) Post production creates ready-to-send messages from the acquired data.
c) Message encryption and decryption algorithms are making the client able to securely communicate to the server.
d) Connection to the TCP socket running at the server side. Sending collected, encrypted data packages, and receiving the server's commands or acknowledgements of the transmission success.

Fig. 3 is intended to visualize client-side operations.

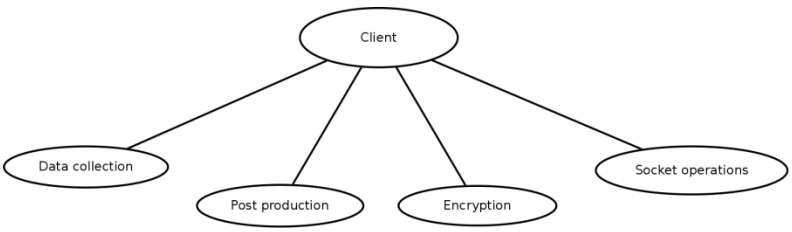

Figure 3. Client-side operations

The listed server- and client-side functions are all realized in software modules. The modules are logically on the same level; none of them can block another or use the CPU-time at the expense of other modules (unless it is desired). One of the most important reasons to choose modular architecture was to make the

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

application's different parts work independently of the others. In case of partial hardware error this feature allows the system to remain alive, with exception of the failing components.

3. MESSAGE QUEUING

According section 1, the application describes many communication contexts. From the furthest point of view, there are two actors: the server-side and the client-side application. All the clients need to communicate with the server in a synchronized, full duplex way, to send collected data and to receive the server's acknowledgement or administrative commands.

From the application context, the actors are the modules which the application is built up. The existence of a communication channel between the actors are elementary, otherwise there would not be any interface to affect the operation of the individual modules.

The phase message queuing summaries the whole process of message transceiving: sending, receiving, storing and error handling. The message queuing solution, which have interfaces to multiple protocols or multiple transport layers is often called Message-oriented middleware, because as a router it stands in the middle and translates messages between different systems or architectures [6], [7].

The presented system is using the ZeroMQ open source software libraries to handle messaging related tasks at both contexts: between the two applications (server- and client-side), and between the independent software modules (the application components). There are two main differences between the transmission methods. The inter-application messages are transmitted on the TCP/IP network, while the inter-process messages are transmitted using a special socket type, developed to link a pair of processes. The second difference is that the inter-application messages are transmitted without encryption.

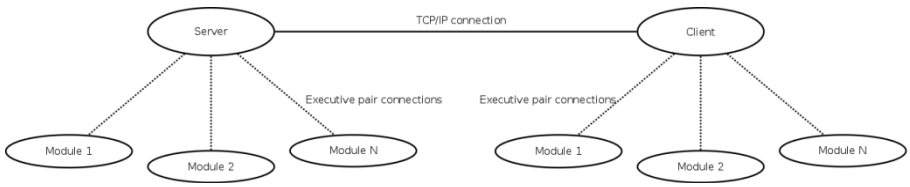

Figure 4. Inter-application and inter-process communication channels

Fig. 4 shows a simplified topology of the communication channels used by the system. The ZeroMQ libraries are designed to create message-transmitting sockets between different systems. Without using ZeroMQ libraries the programmer must handle many special cases, e.g. the fail of the physical layer, and needs to use locks, semaphores and other wait states to avoid the access of the system memory in a concurrent way [5].

3. IMPLEMENTATION

3.1 Interface classes

Both the server- and the client-side have the same object-oriented software structure. An abstract class – called *module interface* – was defined to be the parent class of all the modules. The interface implements the functions which are necessary for the modules to have them started properly and prepares communication channels to the other modules.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

The only task to do by the parent class' constructor is to create a new thread. The thread-creation process consists a few steps – after the creation of the thread itself, a pointer is set to point to the new thread, and then this pointer will be used to call the child class' run method. At this point the module is started properly as an independent thread of execution.

The modules are inheriting many tools and utilities from the interface class, nevertheless this paper will focus on the inter-process communication. UML diagrams, as a standard software-class visualizing tool will be used to represent the base abstract classes [8], [9]. Fig. 5 shows the class diagram of the module interface's C++11 implementation, used at the client-side. The analysis of Fig. 5 will not follow the same order, as shown on the diagram; instead logical order will have a preference.

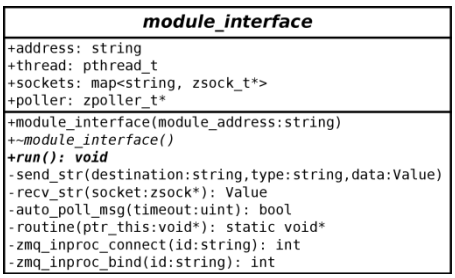

Figure 5. Partial class diagram of module_interface (C++11)

The modules are inheriting the *address* parameter, which will be used to identify the module and to refer to a module instance from other modules. This name must be unique in the application context. The *thread* attribute is the pointer to the class itself, which gets its value after starting the new thread. The *routine* is an intermediate function – it can be called by the new thread creation function and is able to call the child's run function, after the thread creation is done. The *run* function is an abstract method, must be implemented in every module.

The *sockets* is a map object, a container for inter-process sockets. The sockets are prepared for point-to-point communication. To have a communication link between two modules, one of them need to bind and the other one needs to connect to the same channel. This function is implemented through the private member functions *zmq_inproc_bind* and *zmq_inproc_connect*. After having both end of the channel initiated, a full duplex, asynchronous communication channel is ready to use.

The *poller* is also a special ZeroMQ object, which is used to detect incoming data, when multiple sockets have been defined. When the *poller* object is properly initiated, the function *auto_poll_msg* can be used to receive data from either socket defined.

Finally, two remaining functions will be detailed. *send_str* can be used to send a message to another module. The parameters need to include the *address* of the destination module, the *type* of the message, both of them represented by a string, and the *data* itself. The data's type is Value, which is a JsonCpp object type, containing structured data in JavaScript Object Notation form. *recv_str* can be used to receive messages, but it is implicated by the function *auto_poll_msg*.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

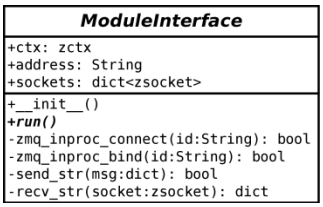

Figure 6. Partial class diagram of ModuleInterface (Python)

Server-side is implemented using Python language version 2.7, Fig. 6 shows the class diagram for the interface class. The paper will focus on the creation of the new module-thread and on the communication functions – other tools and utilities will not be explained.

The *ctx* attribute is needed by the ZeroMQ Python implementation, the pyczmq package. All the software components are getting a copy of this reference.

The *address* attribute has the similar purpose as detailed at the C++ implementation; its purpose is the identification of the module instance. The *sockets* attribute is a container, a Python dict object, which contains references to ZeroMQ sockets. The *__init__* function is the constructor of the abstract class. The only task done by the constructor is to create a new thread, and call the run function of the new instance. The *run* method is abstract, must be implemented in every class inherited from the ModuleInterface.

Functions *zmq_inproc_connect* and *zmq_inproc_bind* have the same purpose as before – the creation of the communication channels between the modules.

send_str is used to send messages on the default socket, which will be explained in the next paragraph. The only parameter is a Python dictionary object, and has a *source*, a *destination*, a *type* and a *data* field. Python dictionary objects have the same structure as a JSON object, so they are easy to translate in both directions. Function *recv_str* can be used to receive messages on the socket specified as a function parameter.

3.2. Inter-process communication

As mentioned before, the modules are using full duplex, asynchronous channels to communicate. Each channel can link two modules. During the normal operation it is sometimes necessary to make a module be able to communicate with more than one other module. One way to solve this problem would be to define a channel between all the modules. Connecting all the modules to each other would result in N(N-1)/2 channels, where N is the number of the modules defined. This would be the most effective solution having regard to transfer rate, but it also makes impossible to have an insight into the communication – e.g. for administration purposes. It would be also necessary to explicitly define the socket at every transmission. Despite the higher resource requirements, a special module, the *core* was defined. The *core* module acts like a router, it is intended to solve the problem of interconnecting the modules and to make possible the inspection of the whole communication. It has a socket to all modules, initiated with the *zmq_inproc_bind* function, so that every module during its start-up can immediately connect to the *core* and send or receive messages.

When the *core* receives a message it checks the header, especially the *source* and the *destination* field. After validating the *destination* field, the core forwards the message to the destination module. At this time, the *type* field has a “request_” prefix. The destination module interchanges the *destination* and the *source*

fields in the message and changes the *type*'s prefix to "reply_". After setting the *data* field, the destination module sends the message through the *core* module back to the originating sender module.

3.3. Inter-application communication

In this paragraph the communication between the client- and server-side applications will be discussed. The communication was implemented using the ZeroMQ libraries, but this time TCP/IP was chosen for the transport layer. The connection is always initiated by a client module. The module sends a message to its *tcp_client* module, which forwards the message on its special socket to the LAN or WAN. After the *tcp_server* module at the server application receives the message, it forwards to the destination module, and the destination module processes the request. The destination module on the server side replies immediately to the client on the established TCP connection, so that the *tcp_client* module can receive the reply. The *tcp_client* module then forwards the messages to the originating module through the *core*.

Since the communication takes place on a non-secured layer, data security must be ensured by cryptographically encoding every message sent over the TCP/IP socket. Elliptic curve encryption method (ECC) was an optimal choice to use for this purpose, because it provides a cost-effective algorithm for data encryption compared to the more common RSA coding.

4. RESULTS

At first, the hardware used for the testing will be detailed. A notebook with Intel Core i5 M560 processor, 8 GB DDR3 memory and a Samsung EVO840 SSD was the first configuration. The second hardware was equipped with Intel Core i5 4210U processor, 4 GB of DDR3 RAM, and a normal SATA HDD. The two notebooks were connected directly using Gigabit Ethernet interfaces, and both PC's were running Debian 7 operation system.

The testing method consisted running one instance of the server application and up to 50 client instances. All the clients were sending the same 1.4 Kbyte size message to the server instance with 1 second interval. The messages were containing the acquired data from 4 different probes. The stability testing of the transport layer was out of our scope.

Every message sent to the server made the following tasks to be performed at the server-side:

1. Receiving the data on the TCP/IP socket.
2. Decoding the received message.
3. Sending back a positive acknowledgement to the client using encryption.
4. Pushing the 4 item to the input buffer.
5. Pushing the 4 item to 4 different database tables.
6. Downloading data checking parameters from the database.
7. Checking values based on the downloaded policy.
8. Checking too old items in the input buffer, and cleaning unwanted items.

Test results:

a) At the first case both, the server- and the client-side application was running on the first hardware configuration. The system had a message throughput about 38 messages per second.
b) 15% increase of the throughput performance could have been reached, by running server-side and client-side applications on different hardware: client application instances were moved to the other hardware. This time the highest message throughput was 44 messages in every second.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

5. SUMMARY

After analyzing many data acquisition related documents ([10], [11], [12], [13], [14]), a demand on creating a multi-purpose framework could be formulated. Therefore, from the business logic approach, the main purpose was to create a system, which can collect data from a wide range of standard interfaces, and aggregate the information into databases easily. The possibility to make fine-tuning and extension of the system simple played also an important role.

The presented solution is able to perform its tasks besides enforcing the rules of modularity. Doing modifications on behalf of optimization is likely to improve the processing speed of incoming messages. The most urgent point of improvement is to achieve greater scalability, by running the server application on more physical hardware simultaneously. Redundancy test cases can be developed thereafter. Another direction of further development is creating intervening modules to extend data acquisition ability with regulatory and controlling features. In the distant future the potential to make the code open-sourced can be seen.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
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DESIGN AND IMPLEMENTATION OF A RADIO CONTROLLED LED LIGHTING SYSTEM

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ABSTRACT

Technological advances allow us to control LED (Light Emitting Diode) lighting at home, in the office it can even allow us to change the intensity of the light and this is just the beginning of what the future holds for us. In this study an LED internal lighting fixture of our own design will be presented focusing on each step in its design. Firstly, the features, types and history of LEDs will be presented, next the products available in market that are required for the completion of the device. Finally, the design and implementation as well as the radio frequency controlled LED indoor lighting fixture will be shown.

Keywords: LED, lighting device, microcontroller, radio frequency

1. INTRODUCTION

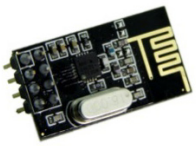
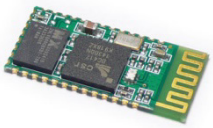
LED technology has gone through a rather fast development as LED efficiency and light intensity is increasing so does it gain a greater foothold in lighting technology and everyday use thus we cannot ignore it as an everyday light source. The secret to the LEDs worldwide conquest and long term success lies in its small size, virtually limitless lifespan and high reliability as an added safety feature the ultra-low voltage required by LEDs make them unique in applications that require electric shock protection [1].
A physical classification of LEDs places them as electroluminescent radiating layered diode in which a P-N layer can be found. A method of comparison can be the luminous flux emitted per unit of power, this also helps divide the application areas [2], [3].
LED ribbons (also known as LED cables) are used to replace traditional light cables as they are more energy efficient. These light sources are no longer manufactured in circular plastic pipes, but on thin flexible PCBs (Printed Circuit Boards). One of the advantages of the flat design is that the light sources always face the same direction making for an even light distribution unlike the pipe design where the direction of the micro light source is mostly random. Another advantage of this design is that the light radiates in a 120° cone, the advantage of this is that all the light goes to producing the light effect as well as not shining through once placed in a polystyrol frame. The LED chip or SMD (Surface Mounted Device) LED are placed lying on the surface unlike DIP (Dual Inline Package) LEDs which stand on their legs. This feature gives them better heat dissipation as well as greater mechanical stability.
From the lighting experience point of view the COB (Chip On Board) LEDs advantage over other LED-s is that the light is generated over a large area enabling fixtures that provide ample lighting but do not blind or dazzle. A MCOB (Multi Chip On Board) LED does not provide light in one great area but rather smaller ones in “cups”. The result of continuous improvement to the LED technology is the OLED (Organic LED) and its sub types the PLED (Polymer LED), PHOLED (Phosphorescent OLED), TOLED (Transparent OLED) other types are still in development [4], [5], [6], [7].

Radio frequency control can be achieved with a simple analog circuit which via frequency or amplitude modulation can provide simplex data transmission for us. In the majority of cases the source and destination for the data to be sent is a microcontroller, and the data are transmitted in digital format. Given this one of the best solutions is to use a transceiver module such as the NRF24L01. A great advantage of this type of modules over traditional transmitters and receivers is that it can achieve full-duplex data transmission, as well as using a protocol where data packets can be addressed, errors can be detected, and

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

in case of errors resend the failed packets automatically. Tab. 1 shows some of the currently used radio frequency modules that are commercially available.

Table 1. Comparison of radio frequency modules

				
Name	NRF24L01	Bluetooth	ZigBee	Z-Wave
Frequency	2.4 GHz	2.4 GHz	2.4 GHz	868 MHz
Max. packet size	33 byte	1024 byte	127 byte	21 byte
Transfer speed	2 Mb/s	237 Kb/s	250 Kb/s	100 Kb/s
Applicable distance	50 m	10 m	150 m	100 m
Price	0.85 €	3.18 €	25.44 €	50.89 €

Bluetooth is a standard with automatic packet handling, which provides a two way data channel in which each master device can connect up to a maximum of 7 other devices, thus one controller unit can control several units. Furthermore the Bluetooth module is rather inexpensive and unlike the NRF24L01 nearly all mobile phones are equipped with Bluetooth thus no further converters are needed.
The ZigBee is developed by the ZigBee Alliance and is built upon the IEEE 802.15 standard. It works in the 2.4 GHz frequency range, uses 16 channels and has a maximum transfer speed of 250 Kb/s. Thanks to the AES-128 it supports encryption with a passphrase providing a secure communication. It can also work in energy saving mode and its range varies between 50-500 m depending on the conditions.
The Z-wave was developed by the Danish Zensys company and is currently being developed by the American Sigma Design. This module builds a self-managing and self-repairing network, using routing tables and neighbour tables to build these routes. Depending on the region they work in different frequencies: 868.42 MHz (EU), 908.42 MHz (USA), 921.42 MHz (Australia) and has a maximum transmission speed of 100 Kb/s.
The NRF24L01 is produced by Nordic Semiconductors, works in the 2.4 GHz range, has a maximum transfer rate of 2 Mb/s with low power consumption, it also has a trade-off between distance and transfer speed. Configuration and operation is possible through the high speed SPI bus. Drawbacks: the module can only have a maximum of 5 open communications if we desire larger networks additional programming is required, furthermore the module has no encryption by default and has to be programmed if need be. From these four modules the most suitable has been chosen based on the parameters given which is the nRF20L01. The decision was made based on the total price of the electronic controller, the ability to connect more modules in a network, low power consumption, and the range should be the longest.

2. DESIGNING A LED LIGHTING SYSTEM

The task presented to us was the replacement of the chandelier which had spotlights and provided the illumination for main room in an apartment. The replacement should be more efficient, have more intense lighting, and consume less power. The spotlights consumed over 200 W of power and provided inadequate illumination. Thus the need arouse to create a ceiling lighting fixture which adequately illuminated the room, consumed less power and had adjustable light intensity. These criteria could only be accomplished by LED lighting. The unique design provided a way to adjust the light intensity allowing for increased energy efficiency and mood lighting [8].

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

The first step was the design of the frame of the lighting fixture. This was done using the Autodesk Inventor program (Fig. 1). The pieces were cut from wooden boards, in the design the following had to be taken into consideration: the individual board segments should be small as possible, the individual segments should look the same, it should be easy to cut out, and the angles should be 90° or 45°. During assembly wooden screws and glue were used to increase the strength of the frame. Finally, the frame had been painted to the desired colour.

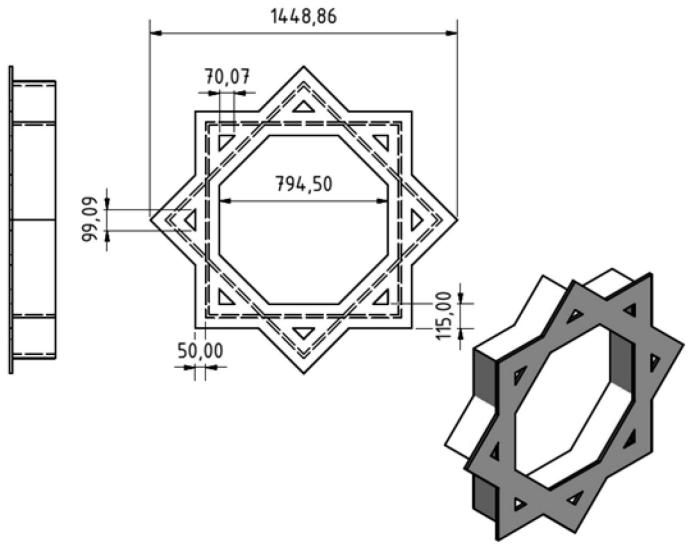


Figure 1. Scheme of the chandelier frame

The next step was the selection of the LED strip. A 12 V 5630 warm white LED strip was chosen which contains 60 LED-s per meter. The 5630 specifies the LED length to be 5.6 mm and width to be 3 mm. The total length required was 8 m which requires 8 A of current. To provide the required current an open factory standard 120 W power supply was chosen, this drives the control electronics as well.

Fig. 2 depicts a block diagram of the control circuit and its subsystems. The block diagram contains the main subsystems: power supply, AVR microcontroller, and NRF24L01 radio frequency module. From the block diagram it can be seen that three levels of voltage are required. The first is the power supply output of 12 V DC converted from 230 V AC, this powers the LED strips. The second is 5 V for the microcontroller and finally the 3.3 V required for the radio module. Since the LEDs and the microcontroller do not use the same voltage converters were used.
The controller selected for this task was the ATmega328 microcontroller from Atmel. This 8 bit microcontroller is rated for 20 MIPS meaning it performs 20 million operations per second if a 20 MHz clock signal is applied [9], [10]. The controller also requires a quartz crystal oscillator to set the clock speed.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

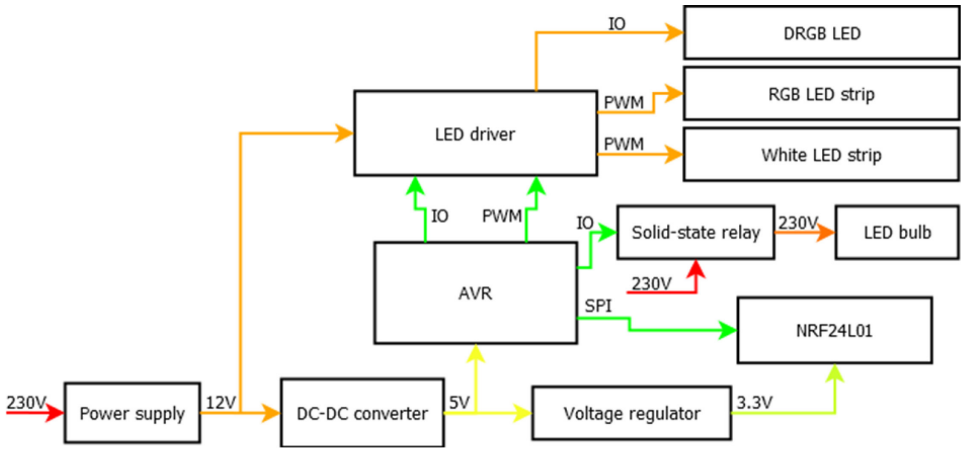


Figure 2. Block diagram of the control circuit

The circuit diagram (Fig. 3) was created using the EAGLE (Easily Applicable Graphical Layout Editor) program, which has the benefit of creating a printed circuit board layout from the circuit diagram (Fig. 4). The printed circuit boards were created using ironing and etching techniques. After the checking of the placement and the soldering the controller program was written.

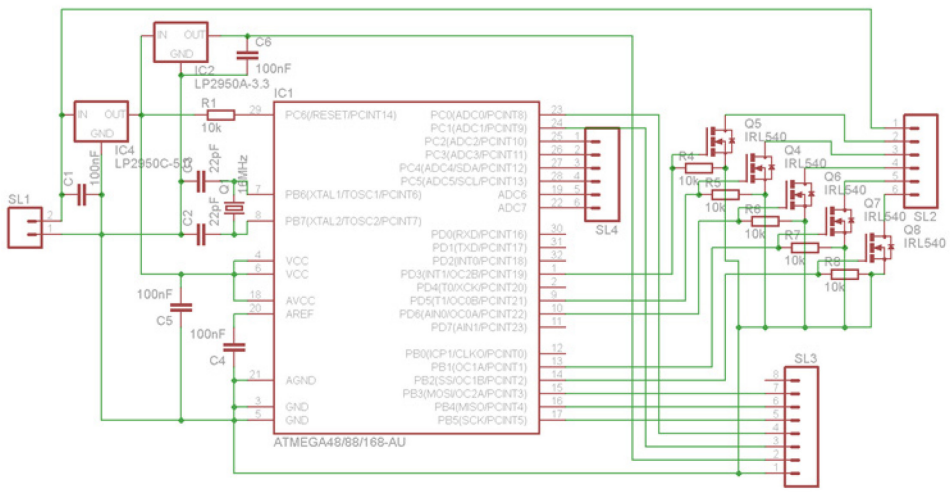


Figure 3. Circuit diagram of the controller

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

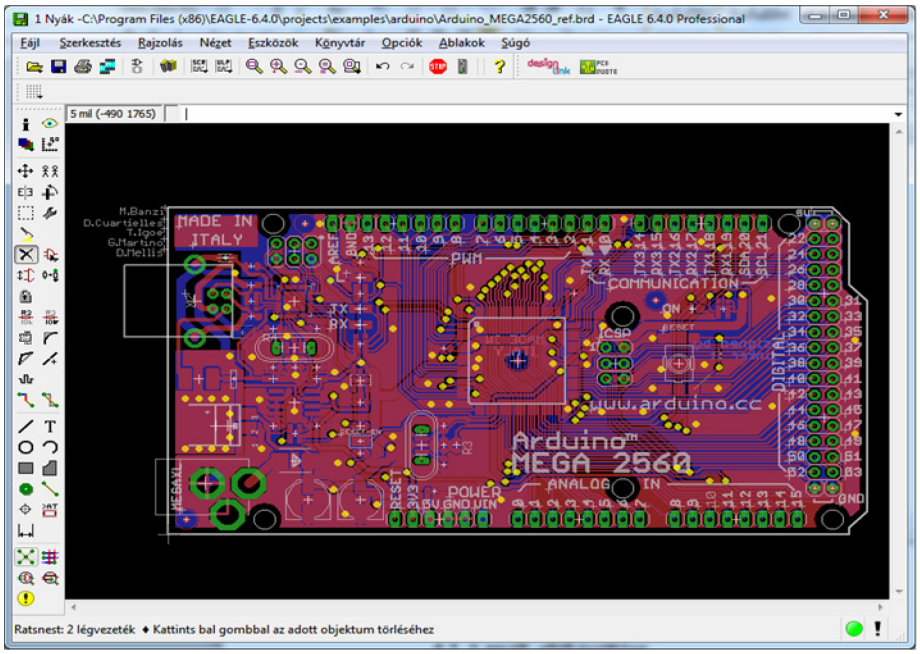


Figure 4. Printed-circuit using EAGLE

Once the chandelier is powered on it should illuminate with a set light intensity just as a regular chandelier, after the initial power up the light intensity and the lighting mod can be set with the remote controller. Thus in the initialization part in the program these variables have to be set to their default values and the input and output pins have to be set, since by default all pins are set to inputs. Furthermore the default state of the outputs needs to be set (high, low), for the inputs we can also set the pullup resistor which ensures the stability of the input if no signal is connected. The next task is to set the PWM generator with the appropriate registers, the module is configured for 8 bit precision, fast PWM generation [9], [11], [12].
Finally the watchdog timer needs to be started, the task of which is to restart the microcontroller if the execution of the program stops or the microcontroller freezes. This is a counter which works on an internal independent clock source, if this counter goes beyond a certain value (overflows) it can set a bit or restart the microcontroller. Once the initialization is complete the main program is run periodically. The objective of this code is to set the light intensity of the LEDs, control the radio module, interpret the incoming packets and to coordinate the execution of the program.
The control of the colour LED strips can be simplified if the three base colours (red, green, blue) are not set individually but rather as HSL (Hue, Saturation, Lightness) values. This way only three variables are needed the colour, the intensity, and the brightness which is more user friendly than RGB colour mixing.
The final step after writing the code for the microcontroller and assembling the circuit was the assembly and placement of the chandelier.

3. LED CHANDELIER

The designed and implemented LED chandelier became the jewel of the living quarters (Fig. 5). Once built the chandelier's functionality could not be fully utilized, since the unique electronics required a remote that could not be purchased commercially, this prompted the building of a remote controller. Once built, all the functionalities have been tested. The required light intensities were reached. The mood lighting could be set to illuminate the room with daylight intensity all the way to evening dimness.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Figure 5. Completed chandelier

4. CONCLUSION

Light is life, the story of lighting will follow that of humanity, not much more than a century has passed since Thomas Edison and his lightbulb still lighting technology has advanced in leaps and bounds. The impressiveness of LED technology lies within the generation of light itself. The light emitting diodes compared to traditional light sources offer vibration free, clear light. The quality of LED lighting can be seen immediately as lighting expenses decrease once installed in a home.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964

Vol. 10, No. 1 2016

ECONOMIC AND NATURAL EFFECTS OF NITRATE POLLUTION OF AGRICULTURAL ORIGIN, IN PARTICULAR THE AQUATIC ENVIRONMENT

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ABSTRACT

The whole area of Hungary is the gathering ground of our principal rivers (Duna, Tisza) and some bigger lakes, like Balaton, Fertő lake and Velencei lake. The water isn't only staff of life; it is one of the most sensitive biotope of world. We suppose to protect our aquatic environment from environmental pollution as such nitrate pollution or eutrophication. Trough agricultural production the nutrient rate increases in water. The weeds begin to pullulate, they are taking up more oxygen from the water, they are necrosis, the depth of warp increases faster so the eutrophication drowns on, and the nitrate rate of rivers increases.

Keywords: environmental economics, water treatment, nitrate, Balaton lake, Fertő lake

1. INTRODUCTION

Our country colloquially known as the "Water country", not in vain, since many of the river travels across the whole territory of the country, our country, the Danube and the Tisza river drainage basin covers the area, and as of great importance, we can take pride as the lake Balaton, lake Velencei or lake Fertő, and we have high-volume underground water resources. However, it is highlighted the water discharge of only 5% of our rivers-the is originated in Hungary, the rest of the water flow through the country, just as the Geographical Institute of the Hungarian Academy of Sciences (MTA FKI) published in paper titled Surface and groundwater [3]. Since most of our vulnerable water-based area, so increasing the protection of our waters.

Starting in the 1960s the industrial farming increased rapidly gaining ground. At the same time the development of agriculture has changed the soil's fertility, physical, chemical parameters. By modernization of agriculture soil fertility of the soil quality can be improved, but above a limit the opposite effect can be seen. Minor changes by easier interaction (e.g. liming) is compensated, or nature can balance it without any intervention, while more serious lesions may cause an irreversible process. [6] Nemeth and co-authors mention in 2007, among others, in the same time, such as nutrient balance displacement, prolonged toxicity of fertilizers in the soil is carried out, in addition to the accumulation of nutrients (e.g. nitrate), which might have adverse effects on your health.

During industrial agriculture time was characterized the production of high yields, by entering a lot of external energy (fertilizer, pesticides, mechanical work) could be achieved [7]. high degree of mechanization was necessary to cultivate large areas, which further increased the environmental impact. As a result of the powerful automation on the soil properties of deteriorated. For example, the content of organic matter and reduction of biological life, acidification, salinization, water table further to restore the power that the subsidence, and the use of chemical substances. High percentage of mechanization and negative consequences of chemical usage was not initially, but later on, in spite of the increasing input use was becoming more difficult to maintain a high average yield, increasingly manifested the dark side of the industrial farming. [1]

The '70s years of fertilizer consumption nearly tripled in Western Europe, which further increased the environmental impact. In vain began the mapping of agricultural regions, on the basis of the average of the samples taken from the fields of the nutrient supply, whereas the then technology did not allow for different levels of application. Not only the industrial agriculture made environmental degradation, but caused big extra cost to obtain the extra inputs. [2]

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Domestic researchers [6, 7] were examined for the period 1970-1990, Hungary is characterized by chemical and it was found that our country's use of fertilizer along the Western European level was also accounts for up to half the chemicals we were able to achieve outstanding yields. According to Kádár [7] in our country so close to 1/3 more exposure than the nutrient has been added. Kádár's (2005) statement was confirmed by Németh (2007). Figure 1 shows the fertilizer spreader. In '70 - '90s were not able to meet the needs of the plant and the soil nutrient content of the fertilizer, therefore implies the positive balance of the soil nutrients.

Figure 1. Fertilizer spreader [8]

Over the last decades in vain was our country's use of fertilizer was under the European average as Kádár (2005) and Németh (2007) confirmed the findings, though significant environmental impact in the agricultural output. The industrial farming is not only degraded but also in our water caused significant pollution. By the bad practice, number of agricultural fields became as nitrate sensitive areas, since the high nitrate content of the water. The water content of the two factors in relation to nitrate test. On the one hand because of the higher nutrient content, on the other hand, the aging of lakes will be accelerated greatly worsens the quality of drinkable water, all this generates a number of environmental and social problems. In addition, it should be noted the fact that the problem of water pollution not only our country, but should be considered as a global societal. The active ingredient of fertilizers in the soil left by the rains deeper soil layers, surface waters of the river waters, which are added to elute. By the rivers to the sea through the active substance, which is the time constant of the water as the world circulation. Millions accumulate chemicals, so that the local acts become global pollution damage to us one day.

2. PROBLEM EXPLORATION

The issue of pollution of agricultural origin nitrate is not new, but the changed climate and social circumstances increasing the timeliness of the issue. Previously, the industrial agriculture in times of high yields was only reaching with high fertilization. The quantity of the active substance in excess of the needs of the plants in the soil, remained on the surface or with rain washed down into the underground waters. Nutritional content in our lakes become bigger, so it makes eutrophication in lakes. The risk of eutrophication, to speed up the filling of lakes. Sedimentation plants lead to death of lakes and makes thick sludge. Becoming increasingly divided waters can easily become established, inter alia reeds, further

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

accelerates the process of lake death. [4] Figure 2 is an example of a eutrophic lake. The reality is that the nutrients due to vegetation proliferates, the decomposition of dead plant bodies dissolved oxygen during the process. Thus the quantity of dissolved oxygen in the water decreases, resulting in the death of plants and animals, which speeds up the sedimentation by siltation of the lake intensified.

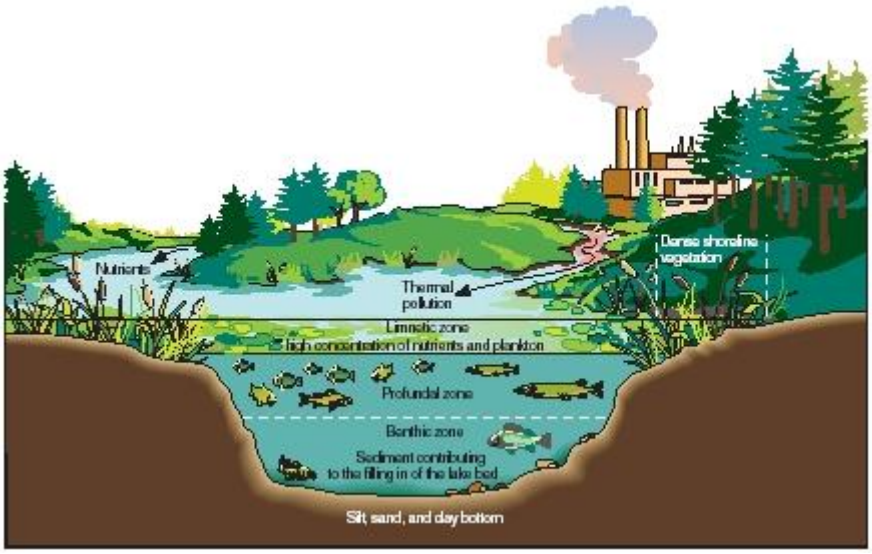

Figure 2. Eutrophic lake [9]

3. ENVIRONMENTAL AND SOCIAL SIGNIFICANCE

The nitrate pollution is a complex problem, environmental, social and economic problems. A point of view could not be parsed. However, you can define priorities, the imaginary is the environmental importance of the topic ranks in the first place, followed by the economic and social points of view.
The water has been transformed into not only the natural nitrification process to speed up. The faster pace of decline in the aquatic living resources. The effect of habitats or native species disrupting the balance of species disappear, the ecosystem. The disappearance of certain species to other species is affected by, for example, how to get foodstuff.
The characteristics of the areas by relaxing in the climate are subject to change, for example, could increase the temperature or humidity of the waterfront areas, reduce the extent of the water surface. Climatic change, the change in average temperature, humidity, precipitation and the amount of influence the evolution of the species comfort zone. The creatures, which are unable to adapt to the changed life parameters is expected to go away. As a result of unforeseen problems we contemplate. For example, a pest that can multiply, control, or against a minor cost not previously had to be taken, since this was the natural enemy. However, the changed conditions disappeared their natural predators so significant additional costs to protect against natural pests.
As soon as I mentioned is not only environmentally tested free of the problem. In addition to the effects on the environment are reflected in, inter alia, socio-economic problems. Contamination of the waters, and in particular the fisheries-fishing cultures (e.g. aquaculture) the possibility of maintaining population living at risk. Mind you, that the supervision of aquaculture waters supplies the fish population intense growth, however, in the case of aquaculture water nitrate-contaminated, which is environment of the production. Figure 3 presents result of pollution where the river fish are killed.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Figure 3. Fishkill in the river[10]

The same importance of water pollution seeing for the fish producers and other private people, whose primary income is the fishing. As a result of the contamination can decrease dramatically the number of the fish population, which maybe makes citizens engaging finish their fishing, which raises social issues (unemployment, supplementary aid, etc.) as well.

4. PROPOSALS TO SOLVE THE PROBLEM

Nitrate leaching can be reduced by proper land use and would be going through cultivation, good farming practice and good agricultural and environmental condition compliance carried out by agricultural production. In addition, positive changes could, inter alia, by the needs of the application of fertilizers plant, stages energy and nutrient needs of calculated doses. In this connection, it may be difficult for the general lack of knowledge of farmers, as more research also confirms that the aging agricultural society with a low level of education.

Typical elementary school 8 grade and secondary high school graduates are employed in agriculture. For the good agricultural practices would be required on a regular basis to learn how to participate in mandatory training sessions for workers in fishing. It means for those who do not take part any programs in which conditional on participation in training is mandatory (e.g., AKG, Natura 2000) do not get update information. They are not acquainted with the current environmental problems (e.g. nitrate contamination), and opportunities for alternative management modes in background. In addition, a new hybrid species is presented (e.g. in study farms), which is better suited to the soil and climate conditions, are also less energy input is similar to the earlier varieties yields (input-output value ratio). [5]

The level of contamination of the nitrates of agricultural origin may be reduced by applying fertilizers and slow absorption, since the soil for a longer period of time are broken down, elute, as easily absorbable form sold as fertilizers.

5. CONCLUSIONS

To solve the problem, it needs for public engagement. Not only must regulate the legal background in creating, checks and imposing sanctions, but the state must participate in the solution through the institutional system. The marketing and communications help, the hosts need to strengthen the

environmental approach to the management idea of conscious as we can do at an individual level, to make a general level of society in order to solve the nitrate problem. If you recognize the farmers against bad practice to reduce nitrate pollution, it would be the solution.
It is underlined in our paper; we are faced with a complex problem. The environmental damage causes economic, social and human problems. Affected areas should not be treated separately. Source should be remedied, which in this case reducing pollution of agricultural emissions.
Instead of sanctions, needs the state economic stimulus measures designed to effectively start the process that the farmers or the social environment of a higher value, because there is just one Earth, we are for the Earth, not the opposite.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
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Vol. 10, No. 1 2016

EFFECTS OF ENZYME TREATMENT ON THE MICROFILTRATION OF ELDERBERRY

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ABSTRACT

The aim of this study was to evaluate the effect of microfiltration (MF) on the antioxidant capacity of elderberry juice using ceramic membrane. Previous to MF measurements preliminary examination was achieved with different enzymes. Four different samples were prepared: one without any enzyme and three with different pectolytic enzymes. The resistances were determined using the resistance-in-series model and difference between four enzyme-treated samples are evaluated. The effect of this technology on the antioxidant component of the clarified elderberry juice has been evaluated in permeate and retentate samples. For ferric reducing antioxidant power was measured with FRAP and total phenolic content (TPC) was determined with Folin Ciocalteau reagent. The total anthocyanin content (TAC) was estimated using spectrophotometric method.

Higher juice yield was obtained using enzyme compared with enzyme-free elderberry pulp. The analytical results show that the MF membrane retained the valuable components in different rate. Significant losses are believed to have occurred after the MF clarification process due to fouling layer resistance, what can be decreased with pectolytic enzymes treatment.

Keywords: elderberry, microfiltration, enzyme treatment, antioxidant, polyphenol, anthocyanin

1. INTRODUCTION

Elderberry plant (*Sambucus nigra* L.) is a good source of many valuable components including amino acids, unsaturated fatty acids, vitamins and mineral elements. It contains high biological activity components: polyphenols, anthocyanins, flavonols, phenolic acids and proanthocyanidins [1]. The elderberry has been used in the treatment of many diseases and ailments in the folk medicines [2]. Reference [3] has shown that the antioxidant activity is exhibited by fruits, flowers and leaves of elderberry.

The antioxidant power of elderberry products is influenced by the steps of preparing method (enzymatic treatment, pressing, clarification etc.). Most of the studies concern changes these compounds in case of fruit juice [4; 5; 6; 7].

In this study changes in antioxidant power (FRAP), polyphenol (TPC) and anthocyanin (TAC) content were investigated during juice microfiltration technology at the laboratory circumstances in case of four different enzyme-treated elderberry juice.

2. MATERIALS AND METHODS

2.1. Materials

The investigated elderberry was harvested in 2015 from grower Nagyvenyim, Hungary. Using for preliminary treatment of juice pectolytic enzymes, ErbiGel and Klar Sol Super were obtained from Kerttrade Ltd. All of the reagents for antioxidant measurements were analytical grade purchased from Sigma Aldrich Hungary Ltd.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

2.2. Juice preparation and enzyme treatment

Juice preparation was performed according to the industrial practice in the pilot plant of the Szent István University, Hungary (Department of Food Preservation).
After the wash and crush steps the berries were treated with three different pectolytic enzymes (Fructozyn BE, Pectinex XXL, Pectinex BE XXL) and one sample was prepared without any enzyme. The enzymes were added to the crushed fruit and left to stand for 1 hour, the amount of enzyme depend on the applied enzyme (Tab. 1) and according to the industrial practice. After the first treatment the pulps were pressed by manual press followed by second enzyme treatment with half amount of enzymes for 30 minutes.

Table 1. **Parameters of enzyme treatment**

Sample	Enzyme	First enzyme treatment		Second enzyme treatment	
		Time (h)	Amount (mg kg^{-1})	Time (h)	Amount (mg L^{-1})
1	-	-	-	-	-
2	Fructozyn BE	1	0.06	0.5	0.03
3	Pectinex XXL	1	0.2	0.5	0.1
4	Pectinex BE XXL	1	0.2	0.5	0.1

Before filtration measurements the pulps were clarified with Klar Sol Super (0.35 mg L^{-1}) left to stand for 20 minutes and ErbiGel (0.1 mg L^{-1}) for 10 minutes.

2.3. Microfiltration

Microfiltration was carried out in the laboratories of the Szent István University, Hungary (Department of Food Engineering). For filtration of enzyme treated juice ceramic tube membrane was used with an average pore size of 0.8 µm and a permeable area of 0.005 m^2. Inside the tube membrane a static mixer was used to enhance the permeate flux. The applied transmembrane pressure was 3.5 bar and the temperature was 30 °C. Cross-flow filtration was applied to remove the suspended solids from the fresh elderberry juice. The scheme of microfiltration apparatus can be shown on the Fig. 1. where juice was recirculated by a pump to the membrane surface. The transmembrane pressure (TMP), the pressure the difference between the two sides of the membrane is the driving force of filtration. Before clarification the pure water and juice flux were determined. The MF apparatus was used at constant 150 L * h^{-1} recycle flow rate.

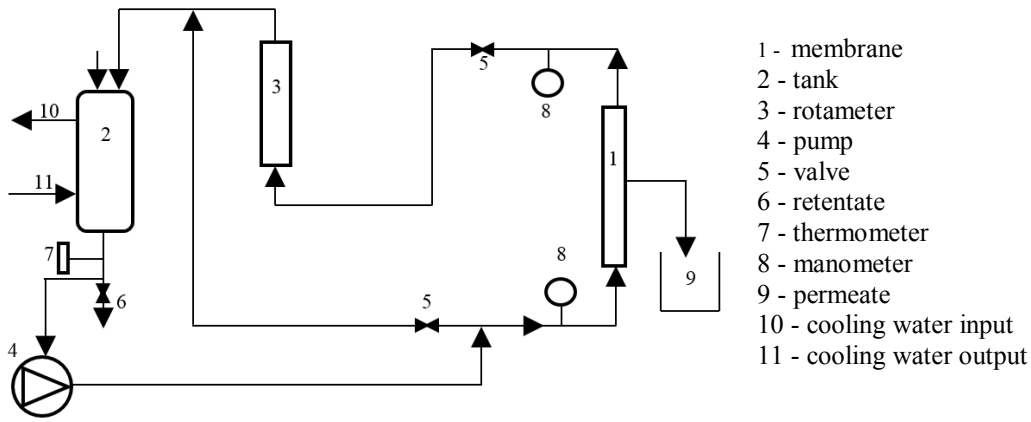

Figure 1. Scheme of MF apparatus

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

2.4. Resistances of filtrations

The membrane-, the fouling resistance and resistance of the polarization cake layer were determined based on the experimental data [8] with the resistance-in-series model (1).

$$J = \frac{TMP}{\eta * R_T} \quad (1)$$

where J is the permeate flux, TMP is the transmembrane pressure, η is the viscosity of the permeate; R_T is the total resistance of microfiltration (2).

$$R_T = R_M + R_F + R_C \quad (2)$$

where R_M is the membrane resistance; R_F is the fouling resistance (caused by solute adsorption into the membrane pores and walls), R_C is the resistance of cake layer, in all cases the viscosity of solvent was taken into consideration. Before (J_W) and after (J_{FW}) filtrations permeate flux was measured with pure water. Each resistance value can be obtained through Equations (3–5).

$$R_M = \frac{TMP}{J_W * \eta_{water}} \quad (3)$$

$$R_F = \frac{TMP}{J_{FW} * \eta_{water}} - R_M \quad (4)$$

$$R_C = \frac{TMP}{J * \eta_{juice}} - (R_M + R_F) \quad (5)$$

2.4. Determination of antioxidant status

Juice preparation was performed in the pilot plant of the Szent István University, Hungary (Department of Food Preservation).
These measurements were carried out from extracted juice. The extracting solvent included 60% distilled water, 29.9% methanol and 1% hydrochloric acid. Stock solutions were prepared by weighing 2 g of each into 50-mL actinic volumetric flasks and bringing each to volume with extracting solvent.
Antioxidant power was determined by the ferric reducing antioxidant power assay (FRAP) [9]. The results are expressed in ascorbic acid equivalent (mmol AA E / L). Furthermore, the total polyphenol content (TPC) of the samples was also determined based on the method of Singleton and Rossi [10] at 765 nm. Results are expressed in gallic acid equivalent (mmol GA E / L). The anthocyanin content was also estimated using a spectrophotometric method described for Fuleki & Francis [11]. The absorbance (A) of samples was measured at 530 nm, data was showed at milligram per litre (mg/L). A Hitachi U-2900 UV-VIS spectrophotometer (Hitachi High-Technologies Europe GmbH, Krefeld, Germany) was used for photometric measurements.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

2.5. Statistical analysis

The statistical analysis has been made by Microsoft Excel 2013. The Student t-test was used to determined differences between resistances of four enzyme-treated samples during microfiltration and also testing for decide whether enzyme caused significant changes in antioxidant content. The P value <0.05 was considered to be significant.

3. RESULTS AND DISCUSSION

In this study four different enzyme treatments (Enzyme-free, Fructozyn BE, Pectinex XXL, Pectinex BE XXL) of elderberry were carried out. The antioxidant status was measured. The raw juice and microfiltrated juice (retentate, permeate) were compared.

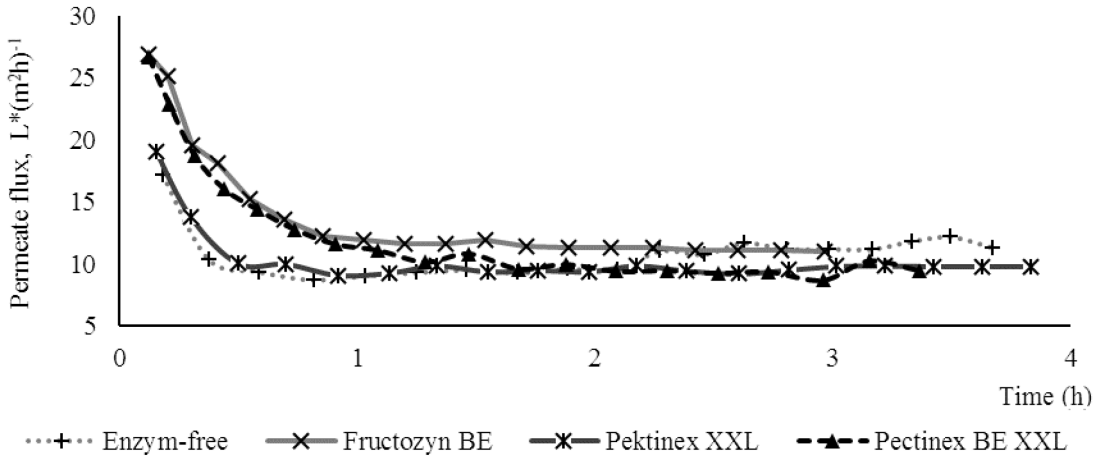

Figure 2. Effect of enzyme treatment on permeate flux during microfiltration.

The data shows the enzymes influenced the microfiltration as well as the permeate flux and the filtration time (Fig. 2). Enzyme treatment enhanced the permeate fluxes of juices and the filtration time was shorter than in case of Fructozyn BE and Pectinex XXL. The best result was using Fructozyn BE enzyme.

Table 2. Resistances of filtration

Resistance	Enzyme free	Fructozyn BE	Pectinex XXL	Pectinex BE XXL
R_M (10^{12} x m^{-1})	2.85 ± 0.19 $_a$	2.85 ± 0.19 $_a$	2.85 ± 0.19 $_a$	2.85 ± 0.19 $_a$
R_F (10^{12} x m^{-1})	30.59 ± 1.13 $_b$	20.48 ± 1.22 $_c$	15.63 ± 1.42 $_d$	26.14 ± 1.82 $_e$
R_C (10^{12} x m^{-1})	63.72 ± 3.12 $_f$	46.62 ± 2.38 $_g$	71.97 ± 2.73 $_h$	51.24 ± 3.26 $_i$
R_T (10^{12} x m^{-1})	97.16 $_j$	69.95 $_k$	90.45 $_l$	80.23 $_m$

Mean ± Standard Derivation
a. b. c. etc. Same letter indicates that the enzyme treatment didn't caused significant changes in resistances of microfiltration at 95% confidence.

Permeate flux of pure water was measured before every filtration of juice. The membrane resistance (R_M) was calculated from this data (Eq. 3).

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Fouling resistance (R_F) was determined from R_M and permeate flux of pure water after filtration (Eq. 4). Results shows significant differences between the R_F values and fouling resistance of Pectinex XXL juice is approximately half of the R_F of enzym-free pulp.
Using Equation 5. the resistance of cake layer (R_C) was calculated from R_F and R_M. The R_C values had a range from $51.24*10^{12}$ to $71.97*10^{12}$ m^{-1} and the significantly highest cake layer resistance was obtained in case of Pectinex XXL pulp. The lowest total resistance of microfiltration was determinated in case of Fructozyn BE enzym treated juice, the highest value was obtained at enzym free sample.
The effect of enzyme treatment and microfiltration technology on the antioxidant components of the clarified elderberry juice has been evaluated in raw, permeate and retentate samples. The antioxidant power, polyphenol and anhocyanin content were measured by spectrophotometric methods. Fig. 3. shows the results of anthocyanin measurement.

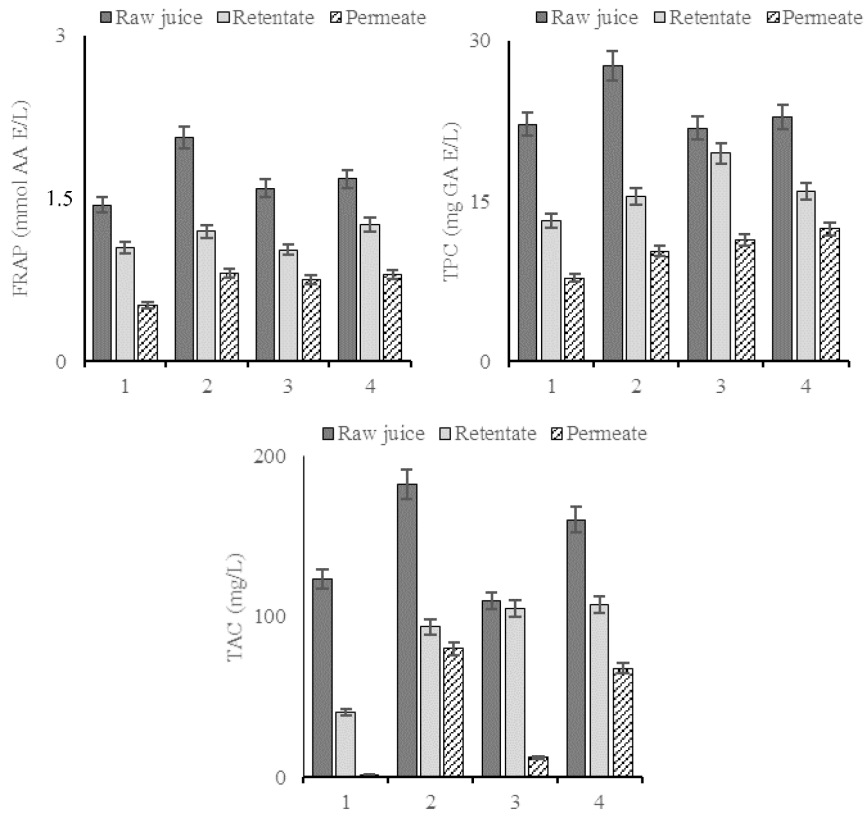

Figure 3. Avarage results of Antioxidant measurements
FRAP: Ferric reducing Ability Power; TPC: Total polyphenol content; TAC: Total anthocyanin content (data shown in mmol AAE/L for FRAP; mg GAE/L for TPC; and mg/L for TAC)
1: Enzyme-free; 2: Fructozyn BE; 3: Pectinex XXL; 4: Pectinex BE XXL

The clarified enzyme-free elderberry pulps presented the lowest antioxidant content compare the enzyme treatment samples. The highest values were shown by raw juice which treated with Fructozym BE enzyme in case of every antioxidant measurements.
The concentration of antioxidant compounds in MF permeate were lower to that in the original elderberry juice in case of all enzyme-treated samples.

The FRAP values had range from 0.52 to 1.68 mmol ascorbic acid equivalent / liter. After microfiltration between the four elderberry retentates and also between the permeates were not observed significant difference.
Total polyphenolic content were between 7.80 to 27.68 mg gallic acid equivalent / liter. The results show significant differences of four enzyme treatment samples and also between the raw juice, retentate and permeate. The TPC values of permeates obtained after microfiltration of the enzyme-treated juice showed a high mean reduction ($p < 0.05$) than the enzyme-free pulp.
The total anthocyanin content has the most difference between the samples. These results had range from 1.74 to 182.43 mg / L. Decreasing anthocyanin concentration was measured enzyme-free pulps from raw juice to permeate.

5. CONCLUSIONS

The analytical results show that the MF membrane retained the valuable components. Significant losses are believed to have occurred after the MF clarification process due to fouling of membrane pores, what can be decreased with pectolytic enzymes treatment.
Research results of Reference [4] is the same, according to the reduction of the antioxidant capacity of the permeates obtained after microfiltration of the enzyme-treated juice was higher than that obtained using enzym-free pulp.
The best pectin hydrolysis and antioxidant component recovery were reached by using Fructozyn BE enzyme treatment due to the lowest fouling layer and polarization layer resistance. The results show that the pectolytic enzyme treatment had a positive effect on the microfiltration process of elderberry juice.

6. ACKNOWLEDGEMENT

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Analecta
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Analecta Technica Szegedinensia
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Vol. 10, No. 1 2016

KURGANS: MARKERS OF THE HOLOCENE CLIMATE CHANGE(S)

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ABSTRACT

The burial mounds, living mounds, guarding and border mounds (group name is "kurgan") have been under environmental protection in Hungary since 1996. Besides the fact that they are important elements from archeological point of view, in many cases they reserve valuable remaining parts of onetime steppes, and studying of their buried soils can provide new data to learn more about the ancient environment, flora and the soil-formation processes took place long ago. In this way it can be obtained information about the Holocene climate changes.
Our research team had seized the opportunity to examine several kurgans located in the Great Hungarian Plain. Two of them – the Csípő- and Lyukas-mound – has been examined in precise details through the involvement of experts of various disciplines. Due to this cooperation we could extend our researches and knowledge on the biogenic genesis of paleosoils and paleoecology concerning our kurgan studies. Therefore we utilized biomorphic analysis besides pedological investigations.
Though the differences in sampling methods were significant, but the existence of a buried, ancient, undisturbed soil profile can be stated. According to morphological description of soil that was done after the kurgan's excavation and drillings, we conclude that both the modern and paleosoils of the kurgans belong to Chernozem type soils, formed under predominantly arid steppe vegetation. Due to this fact we assume that the ancient environment of both kurgans was similar in many points with the modern landscape. Hence instead of closed forest vegetation rather loess-steppe or semi-shaded steppe can be reconstructed as the former environment of the mounds, which was mosaicly surrounded by water and salt affected areas. These results demonstrate that in the Carpathian Basin the Holocene climate changes are characterized by rather evenness, and but not the previously assumed character changes.

Keywords: mounds, markers, pedological, morphological examination

1. THE ROLE OF KURGANS IN PALEOECOLOGICAL RECONSTRUCTIONS

All anthropogenic formations that can be grouped under the the term 'kurgan', such as tells, border-, guard- and burial mounds, are under the protection of natural conservational law in Hungary since 1996. Besides their archaeological importance they preserve valuable remnant areas of steppe lands. The examination of the mound-body, the buried soil profile underneath and its surroundings can yield data on the reconstruction of ancient environments, the vegetation cover and the changes in paleo- and recent soil development [1] [2] [3].
However the analysis of the paleoenvironment through geomorphological, geological, paleontological investigations and archaeological excavations already began in the nineteenth century [4] [5], these methods have only been put into practise in Hungary recently. As a forerunner of these tendencies, Ref. [6] has undertaken the geoarchaeological research of a Bronze Age tell, the so called Test-mound located near Szakáld. Similar geomorphological and stratigraphical investigations of the Büte-mound and other kurgans situated on the southern plain territories of the Hortobágy National Park has been carried out by [7]. Ref. [8] has reconstructed the original soil profile buried under a Bronze Age tell near Százhalombatta by applying pedological examinations. Similarly, the paleoenvironmental conditions and site formation processes of Bronze Age settlements were carried out in numerous geographical area of the Carpathian Basin [9] [10].
The pedological survey of kurgans allows us to become acquainted with certain qualities of the recent and buried soil profile, to specify our knowledge on the trends and rate of soil development. The statement of Dokucsajev (1846-1903) that „*soil is the mirror of the landscape*" is still a sound observation nowadays. Through the examination of soils, changes in landscapes can be revealed, while the 'answers' of soils, there stability, can be measured through an environmental optimum [11]

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Presumably mounds were erected in one or more steps by heaping up the soil material in their closer environment [12] [13] [14]. Buried under the mound-body lies the isolated and conserved, several thousand-year-old soil profile, which preserves the attributes of ancient soil development.

2. SAMPLING SITES: THE CSÍPŐ-MOUND AND THE LYUKAS-MOUND

The Carpathian Basins alluvial plain is covered by loess and loess-silt. Small ridges of loess-sand and higher shifting-sand dunes emerge from the plain territory of the region that makes its relief conditions diverse. The annual mean temperature varies between 9.7-9.9 ˚C, while the climate is moderately warm and dry. The annual mean precipitation is around 550 mm-s. The usual wind direction is north-eastern, northern and south-western. The hydrology of the area is characterized by aridity, scanty runoff and water shortage. A small quantity of ground water is found in a depth of 2-4 meters beneath the ground level. Potential vegetation imply loess steppe lands, salt-affected areas and wet meadows. Huge territories of this region are home to agricultural production. Mosaics of Chernozem type soils with Solonetz soils and Vertisols are found in this landscape. All above mentioned factors, such as the geological, climatological and micro-geomorphological conditions determined the soil development of this microregion.
Getting to know the early environment of the sample area (Hortobágy and Hajdúhát) selected for the research was of key importance from the point of view of describing soil formation in Hortobágy: there are two different hypothesises drawn up regarding the formation of the Hortobágy steppe areas and the saline areas appearing amongst them. According to one scientific opinion in the Holocene, similarly to the other Great Plain areas, the Hortobágy was covered by forests, and the loess steppes appearing at the higher, island-like locations were surrounded by closed forests, while saline areas had not appeared yet [15] [16] [17] Under this interpretation the saline areas of the Hortobágy can be considered as secondary, their formation can be traced back for only a few centuries and their appearance is mainly due to the river regulations and forest clearance.
According to the other opinion, there could be no permanent, extensive coverage of the Hortobágy with forests. Salinization already appeared at the end of the Pleistocene, existed continuously throughout the Pleistocene, while large animal breeding cultures which settled in the barren areas, as well as river regulation in the 19th century only extended and stabilized the saline areas [18] [19] [20]. According to the latter hypothesis, salinization developed due to the connected parent material, climate and special geomorphologic conditions, and the saline soils have been the peculiarity of the Hortobágy and the Hungarian Great Plain for long millennia.
In order to get to know the previous environment of the Hortobágy, our target was the pedological study of the selected kurgans (Fig. 1., Fig 2.).

Figure 1. The Csípő-mound

Figure 2. The cross-section of the Lyukas-mound

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

The tasks were as follows:
The structure of the kurgan body was specified by pedological examinations, and the "conserved" characteristics of the buried soil.
The recent soil of the kurgan was compared to the buried soil formation, and to the soil formation of the wider surroundings.
We aimed to reconstruct the environment of the earlier soil formation of the several thousand years old kurgan, and to specify the changes in the soil formation.
To gain data on climate change trends of the Holocene based on the comparison of buried and recent soil profiles.

3. MATERIALS AND METHODS

The pedological survey of the area surrounding the kurgan was carried out using a Pürckhauer soil-sampler [21]. For the 1 m deep samples soil type, colour, physical type, carbonate-, pH and soil-moisture examinations were carried out; we determined the depth of the soil horizons and the soil types, as well as the soil spots were roughly separated.
The instrument for the pedological study and the sample taking of the Csípő-mound kurgan's body was a Styl-spiral auger with two arms. The diameter of the boring head was 5 cm, the length of the auger was 100 cm and the lengths of the matching arms were 100 cm long. The principle of the sampling was the Birks-type paleoecological mapping boring taking into consideration the space-time dimension [22]. Five borings were started in the top third of the kurgan body, with the objective to study the material of the kurgan and the soil buried by the kurgan.
We examined the differences in colour, structure, moisture and compactness on the spot based on the morphological description of the samples recovered by the shallow geological drillings. Independently from the layers and/or horizons we examined the lime content in every 10 cm. We registered the location of the visible concretions, morphological signs (root-interweaving condition, animal tunnels, iron separations, calcium and silica separations, bones etc.). Based on the morphology we separated the material of the borings into layers/horizons, which we classified and prepared for later examinations.
In the case of the Lyukas-mound kurgan our research group had the possibility to examine its stratigraphy on a whole cross-section. Excavation permissions [23] [24] were obtained at the beginning of 2004. Soil sampling with Pürckhauer sampler was made in the surroundings of the kurgan. An excavator was used with the supervision of archaeologists and pedologists to excavate the site. After the machine work, human labour was used to clean and to precisely excavate the remaining smaller areas. The research trench was deepened till we reached the horizon of the former parent material. On the cross-section we examined the differences of the separate layers in colour, carbonate content, moisture and texture. We recorded the location of visible morphological keys (e.g. crotovinas, iron, lime and siliceous precipitations, bones, etc.). Description of soils was made according to the Hungarian soil classification system. From the view of pedological research, priority was given to assess soil development and process of soil genetic [25].

4. RESULTS

The soil conditions of the area surrounding the kurgans showed a mosaic pattern. Although the prevailing parent material is everywhere the loess type alluvial fundamental rock, according to the groundwater levels and micro-morphological conditions there are different types.
At the areas, where the loess remained in elevated heaps, there remained drier soil formations, and the prevailing soil was the Chernozem. Soil development shows humus materialisation, but due to unsuitable agro-techniques the structure of the upper horizon is degraded and occasionally leached. The heap-up area of the kurgan has been covered through the years due to human impact, so it can only be sighted near the north-western wall. Pseudomicelliar Chernozems are strongly degraded in their A-horizon, their structure is crumby and powdery with a squeezed, compact layer. In the B-horizon lime concretions can be found between 30-70 cm-s. This horizon is light, gray coloured and easily falls apart to its structural elements.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Traces of animals, such as crotovinas are visible. Parent material is loess type sediment with carbonate precipitations.
The soil conditions were also clearly indicated by the vegetation [26]. The locations and presence of the small loess heaps and the meadow soils are also shown by the loess vegetation (*Salvio nemorosae-Festucetum rupicolae* (Zólyomi 1957 ex Soó 1964) typical for the drier steppes.
The typical soil of the water flows, benches, and lower areas is the meadow Solonetz. Based on our on the spot examinations we could also register traces of a stronger water effect in the parent rock of the soil type (gleying), and the A-horizon was often destroyed due to benching, the typical erosion of salinity. These saline spots – located at the lower points of the kurgan foot and in the surrounding of the kurgan – are covered by the associations of alkaline meadow (*Artemisio santonici-Festucetum pseudovinae*, Soó in Máthé 1933 corr. Borhidi 1996).
From the five borings started on the Csípő-mound kurgan body the first three originated from the centre of the kurgan and reached the depth of 580 cm. The other four borings were located according to the corners. They were initiated from the top third of the kurgan. Their depths were: 480, 405, 405 and 405 cm-s, respectively.
In the recent, top soil formation of the kurgan body, invariably the 20-30 cm deep, dark coloured, crumbly structured A-horizon woven with roots was clearly identifiable. Below this a horizon with the depth of 50-70 cm was found, showing the carbonate dynamics typical for Chernozem B-horizon; lime incrustation was found only in three borings.
When boring deeper the usual fundamental rock was not encountered, since in case of the recent soil of the kurgans the "parent material" is the humus soil piled up as the material of the kurgan, with uniform dark brown colour. This cultural-anthropogenic layer, being sharply different from the recent soil in structure, being compact and shelly when dry, in downwards profile shows hydromorphic characteristics, stronger compaction and contains remnants of bones, as well. We could detect calcium carbonate in the culture layers only in traces.
Under the layers, which can be considered anthropogenic, there was a level with medium crumby structure, with higher lime content, 20 cm deep and dark brown. This horizon, which we determined as the paleo A-horizon, changed with a 30-50 cm paleo B-horizon into the appearing loess-type parent material.
The order was identical in the case of all core samples; the depths of the layers were different, mainly explained by the geomorphology of the kurgan.
Based on the lime, organic matter and salt dynamics, steppe (Chernozem) type, dry soil formation applied to the recent soil of the kurgan body. The cultural layer was piled up from the surrounding soil cover, which was characterised by high organic matter content. Many parameters of the buried soil were identical to the parameters of the cultural layer soil, indicating similar origins. The texture was uniform throughout the whole kurgan, no argillization and lessivage appeared, only slight traces of wash out could be found, therefore there were no signs of forest soil formation.
On the basis of the pedological, morphological examination of the different layers and horizons of the Lyukas-mound kurgan we conclude that the recent, modern soil covering the moundbody belongs to Chernozem type soils and attributes all relevant chemical and physical qualities of these soil types. In its loamy textured A-horizon, moderate carbonate content can be measured, which increases slightly in the B-horizon. The so-called Chernozem-dynamic can be identified, through the slow, moderate decline in organic matter content and increase of carbonate content in vertical depth of this layer. The pseudomicelliar horizon was encoded with a separate marking.
Underneath the modern soil, three cultural layers can be found. Amidst these layers horizons presumably showing soil development can be sighted. Their thickness depends on the hypothesized time-period between two separate heap-up processes. The material heaped up to form the mound derives from the soil horizons of the surrounding environment. This statement is supported by the dark colour, the significant organic matter content and the loamy texture.
Underneath the moundbody lies the ancient, original soil formation which can be separated into several horizons due to its morphology. The paleo A-horizon and the paleo B-horizon show resemblance with the recent, modern soil in terms of organic matter content, carbonate dynamics and texture. It is characterized

by loamy texture besides other indicator identification keys which classifies it as a Chernozem type soil. This allows us to conclude that the buried paleosoil of the Lyukas-mound kurgan reflects soil conditions similar to recent development. The parent material is a pale yellow, highly carbonated, loamy-textured and structureless sediment.

5. CONCLUSIONS

Based on the pedological examination of the Csípő-mound kurgan and its surrounding, more than 6000 years ago we encountered flooded areas in the internal part of the Great Plain. In this waterlogged environment only the erratically stretching Pleistocene riverbacks covered by loess were dry areas. On the emerging ridges the Chernozem soil of the grasslands was formed. Human populations of the Copper and Bronze Age – accordingly to their cultural traditions – buried their dead on these drier, slightly elevated areas, and built a kurgan over the deceased person from the soil of the surrounding area.
The high salt content of the groundwater not only had an impact on the soil under the kurgan, but also on the characteristics of the soil formations in the lower areas between the loess ridges of the surroundings. Therefore in the surroundings of the kurgan, not only meadow soils, but in parts of the lower areas, saline soils could also be found, which alternated each other in mosaic arrangements, still visible today. So the saline areas in the examined area could be considered as early, and existed already at the beginning of the Holocene, while the river regulation did not create them, but only stabilized them.
The surrounding environment of the Lyukas-mound kurgan is dominated by a typical Cherozem type soil. After the cross section preparation we could identify 10 separate layers. Arid, Chernozem type soil development is typical for the uppermost layer of the kurgan and though its 'parent material', which is a result of human heap-up, is rich in organic matter and can already be considered as a developed soil formation, the recent, modern soil covering the kurgan's surface bears the identification keys of typical Chernozems, such as the crumby structure, carbonate dynamics and bioturbation.
All our pedological results support the idea that the buried soil is Chernozem, which formed under predominantly arid (in some places wetland patches were possible) steppe vegetation. Therefore the ancient, peleoenvironment showed similarities in a number of points with the recent, modern landscape and its development was determined by climatic and vegetation factors typical for steppe land environment.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
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STRUCTURAL CHARACTERISATION OF STARCH BASED EDIBLE FILMS WITH ESSENTIAL OIL ADDITION

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ABSTRACT

Present study investigated structure of starch based edible films with essential oil addition. Films were obtained from water solutions containing gelatinized modified starch, polyol, guar-xantan gum modified mixture and essential oil by casting it on a Petri dish and evaporating at room temperature for 72h. Both, glycerol and guar-xantan modified mixture, had role to improve film flexibility and enable better film folding and handling. Two sample groups were obtained: starch based edible films with black cumin oil addition and starch based edible films with black pepper oil addition. Both essential oils were added in three different concentrations. Starch based edible film without essential oil addition was used as blank shot. Structural properties were determined by analyzing spectra obtained by FT-IR Spectrometer in the spectral range of 4000–400 cm^{-1} with a 4.0 cm^{-1} resolution. Software Omnic 8.1. and TQ Analyst were used to operate the FTIR spectrometer, collect and present all the data. Results pointed to quantitative law dependency between added amount of essential oils and spectra absorption values for both sample groups and FTIR spectra were used to calculate coefficient of correlation.

Keywords: packaging, edible films, starch, structural characteristics

1. INTRODUCTION

One of the matters of great concern nowadays is the environmental impact caused by the excessive quantity of non-degradable waste materials discarded every day. This reality has been stimulating research to develop new biodegradable packaging materials that could be considered environmentally friendly raw materials (Avérous et al., 2001). Among these materials, the ones derived from renewable resources, which participate in the carbon cycle, has received more attention since they combine environmental benefits and sustainability.

Edible films are thin layers of biopolymers that are used for the food packing. Edible films may be used to separate layers having different water activities retarding water transfer from one layer to the other (Guillard et al., 2003), may be a barrier for oxygen decreasing oil or fat oxidation, could be used as a barrier for oil uptake in deep fat frying (Holownia et al., 2000), used as a carrying agent for antimicrobial or functional substances (Han, 2002). Edible film coating with encapsulated antimicrobial substances can retard growth of microorganisms (Ko et al., 2001).

Several studies reported the use of starches from different sources to prepare films and coatings with different properties, and have indicated that these carbohydrates are promising materials in this regard (Avérous et al., 2001, Larotonda et al., 2005; Mali et al., 2005). Starch is one of the most frequently used biopolymer for edible films production due to the fact that could be obtained from large number of raw materials, its production costs are cheap, it is renewable and biodegradable biopolymer that has the ability to form films. Films developed from starch are described as isotropic, odourless, tasteless, colourless, non-toxic, biologically degradable, thus prevent a change of taste, flavor and appearance of food products (Chiumareli and Hubinger, 2012).

The main components of starch are linear amylose and highly branched amylopectin composed of glucose units via α-1,4 bonds (Blanshard, 1987). The ratio of amylose and amylopectin in the starch may affect starch behavior in processing and properties of the end product. They both consist of α(1–4) linked D-glucose units. Amylose is essentially linear, whereas amylopectin is a highly branched polymer due to 5–6% of α(1–6) links (Buleon et al., 1998). The native structure of starch is made of helices that are more or less radially organized forming a granule, which has to be described at different length scales. Some

structural aspects involving the arrangement of the molecules inside native starch granules and starchy materials are still matter of debate.
However, the application of starch films is restricted owing to the brittle nature (Imberty and Perez, 1988). The brittleness of starch materials is, among other things, mainly due to strong interactions between starch macromolecules (Takahashi et al., 2004), which may confine the polymeric segmental mobility (Muscat et al., 2011). Polymeric segmental mobility can be improved by doping some hydrophilic plasticizers, as a result of having interactions between plasticizer–starch instead of between starch–starch. Glycerol is one of the most popular plasticizers used in film-making techniques, due to stability and compatibility with hydrophilic bio-polymeric packaging chain (Fernandez Cervera et al., 2004).
The addition of essential oils and other components with antioxidant activity can improve functional properties of edible films and increase their potential use in the preservation of foods with a high fat content. Despite the great potential of essential oils, their use in food preservation remains limited mainly due to their intense aroma, toxicity problems and possible changes in the organoleptic properties of the food (Sanchez-Gonzalez et al., 2011). The use of edible coatings to carry essential oils could minimize the required doses by the encapsulation effect in the polymer matrix, which limits their volatilization and controls the compound release, thus reducing the negative impact of these ingredients.
The infrared spectroscopy, considering interactions at a local range order, has already been used to describe the organization and structure of starch films. The IR spectrum of starch has been shown to be sensitive to changes in molecular structure (short-range order), such as starch chain conformation, helicity, crystallinity and the retrogradation process as well as moisture content (Goodfellow & Wilson, 1990; Van Soest et al., 1995).
In this work, we investigated effect of essential oil addition on starch based film structural properties by using FR-IR spectroscopy method. FTIR spectra were used to make quantitative law dependency between added amount of essential oils and spectra absorption values for both sample groups to calculate coefficient of correlation.

2. MATERIALS AND METHODS

2.1. Materials

Film preparation: Starch films were prepared by casting aqueous starch solution. Aqueous solution of 2% (w/w) modified maize starch was prepared and heated at 90 ^{0}C for 60 minutes in a water bath. A weight of glycerol equal to 60% of the original starch was added and the solution was kept hot with mechanical stirring for 10 more minutes. Finally, guar-xantan modified mixture was added in a portion of 0.5% to initial starch weight. Guar-xantan modified mixture had role to enable better film folding and handling. Two different essential oils were added: black currant oil and black pepper oil in same concentrations in both cases: 0.5, 1 and 2% counted on mixture volume. Starch based edible film without essential oil addition was used as blank shot. The film-forming solution was homogenized using homogenizer at 10000 rpm for 1 min and then degassed under vacuum to remove dissolved air and then cast into Petri dishes. Each Petri dish was coated with 50 g of film forming solution on a leveled surface and left to dry at room temperature for 3 days.
Starch and guar-xantan modified mixture were kindly provided by “Palco” (Šabac, Serbia) and glycerol was purchased from „doo Laboratorija” (Novi Sad, Serbia).

2.1. Methods: Fourier transform spectroscopy

FTIR analysis of the film samples was carried out in the wave number range 4000 to 400 cm^{-1}, at a resolution of 4 cm^{-1}, using the IR spectrophotometer, Nicolet IS10, Thermo Scientific (Massachusetts, USA) and attenuation total reflection (ATR) extension. Each sample was scanned 32 times, while background shot was taken before the analysis of each sample. IR spectrophotometer is controlled via

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
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Vol. 10, No. 1 2016

computer equipped with software Omnic. Software Omnic 8.1. and TQ Analyst (Thermo Fisher Scientific, MA, USA) were used to operate the FTIR spectrometer, collect and present all the data.

3. RESULTS AND DISCUSSION

According to visual examination obtained films were transparent, odourless, easy to handle. It was proved that casting is adequate and easy process to produce films on a laboratory scale. Solvent is evaporated from the solution in order to form the film (Anker et al., 2001; Lazaridou and Biliaderis, 2002; Rindlav-Westling et al., 2002). Films were not greasy or sticky which means that amount of added plasticizer and guar xantan modified mixture was optimal. Previous research proved optimal concentrations (Šuput et al., 2013).
FTIR spectra may be used to define molecular interactions and some chemical components (Ferreira et al., 2009). An extremely broad peak appeared between 3000 and 3600 cm^{-1} centered at 3300cm^{-1}. This is the region of hydrogen-bonded hydroxyl groups associated with free, inter- and intra- molecular bound hydroxyl groups (Haq et al., 2014). The peak occurring at 1641 cm^{-1} is associated with the tightly bound water present in the starch due to the hygroscopic nature of starch which is in agreement with findings of Zhang & Han, 2006. The peak at 1409 is related to the CH bending of CH_2. Peaks at 1240, 1299 and 1333 cm^{-1} are associated to OH bending due to the primary or secondary alcohols (Coates, 2000). Peaks at 2926, 1450 and 1370 cm^{-1} are ascribed to C-H stretching and bending modes which is in agreement with findings of Sheng et al., 2011. In two regions sample spectra show differences. First one is 1680 – 1770cm^{-1} which is presented in Fig 1. Generally, in spectral region 1800–1540 cm^{-1} starch doesn't absorb in it so the origin of these differences is from added oils. Based on IR spectral interpretation, samples with black cumin proved to have aliphatic ester groups: unsaturated groups at 1715cm^{-1} and alpha keto at 1745cm^{-1} while spectra of samples with black pepper had no peaks in this region. The other spectral zone where spectra differ is 2820-2980cm^{-1} which is shown at Fig 2. Based on IR spectral interpretation the CH_2 asymmetric stretching vibration occurs at at about 2930 cm^{-1} while symmetric CH_2 vibration occurs at 2870-2840 cm^{-1} for both group of samples but film samples with black cumin addition further have olefin functional group. Functional group is detected as C-C Stretching Vibrations and C-H Stretching and Deformation Vibrations.

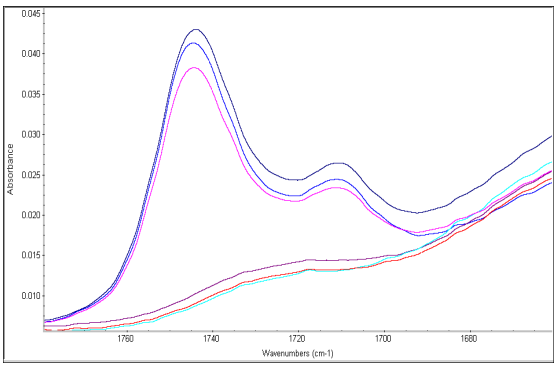

Figure 1 Differences in spectral region 1680-1760cm^{-1}

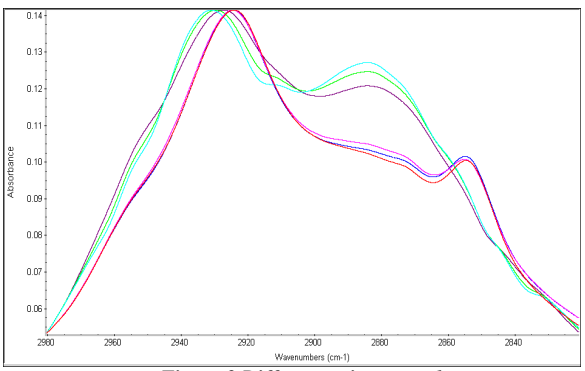

Figure 2 Differences in spectral region 2840-2980cm^{-1}

Using software TQ Analyst, quantitative analysis Simple Beer's law was performed on spectra of starch based edible films with growing amount of two different essential oils: black cumin and black pepper. Functional dependency, described by equation:

$$y=(0.709e-3)x+(-0.230e-3) \quad (1)$$

was determined between the amount of added black cumin essential oil and the FTIR spectra of starch based edible films with growing amount of oil, in the spectral region of 3275.50-3281.29cm^{-1}. Calculated versus actual values showed very good correlation (R^2=0.99617) for the linear function.

Functional dependency, described by equation:

$$y=(-0.459e-3)x+(0.856e-3) \quad (2)$$

was determined between the amount of added black pepper essential oil and the FTIR spectra of starch based edible films with growing amount of oil, in the spectral region of 3275.50-3281.29cm^{-1}. Calculated verses actual values showed very good correlation (R^2= 0.99321) for the linear function.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
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THE EFFECT OF SEED TREATMENTS ON THE GERMINATION OF DIFFERENT FABACEAE SPECIES OF A NATURAL MEADOW-LIKE ASSOCIATION

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ABSTRACT

The goal of our experiment is to compose a species-rich seed mixture suitable for soil covering in orchard floor management in organic fruit production systems. Besides selection of traditionally used grass and *Fabaceae* species we are focusing on the involvement of local fora elements, of the experiment site, approaching a natural meadow-like association.
Species of the following plant families are involved: Apiaceae, Asteraceae, Rosaceae, Linaceae, Polygonaceae, Dipsacaceae, Fabaceae, Poaceae. Seeds of selected species were tested to determine germination % before seeding, according to MSZ 6354-3:2008 standard in climate cabinet. Seed treatments (vernalisation, scarification) were carried out according to relevant standard.
There were differences in the germination% of commercial and wild collected seed items of *Agrimonia eupatoria* L, *Ajuga genevensis* L, *Lotus corniculatus* L, and *Achillea millefolium* L. The applied seed treatments resulted significant difference between the treated and non-treated seed items most of the tested species related their germination%. For example in case of *Anthyllis vulneraria* L it was effective. Scarification was effective for commercial hard seed species like *Lotus corniculatus* L in our case, but it was not effective for *Agrimonia eupatoria* L.
The aim of the treatments was to select those species which can be seed in the same time, will be easier applied to soil and climatic condition of the experiment site and to determine effect of pre-treatments on germination % of seeds of tested species.

Keywords: seed mixture, Fabaceae, hardseededness, seed germination, seed pre-treatments

1. INTRODUCTION

The application of ground cover plants has numerous advantages in ecological fruit production, where the ground cover represents an important criterion. The most important is the reduction of erosion and deflation effects, the weed management, the preservation and improvement of water and nutrient contents of the soil, and the reduction of nutrient leaching.
In fruit production the application of soil covering living mulch has an important contribution in weed regulation. The emphasis is on the prevention, and to keep the damage under the economic threshold level. To reach that goal it is an often suggested method to apply living or dead mulch, green manure, or to sow weed suppressing plant species. In the same time it is not allowed to use any kind of synthetic products, herbicides, or plastic mulch containing chlorine. [13]
The application of soil covering plant mixtures has advantageous (on soil compaction, structure, protection from erosion, water preservation, host plants for beneficials), and disadvantageous (competition for water and nutrient, host plats for pests) effects on soil properties, and in plant protection.
All of these multiple effect determine the selection of proper plant species fitting into the character of the orchard and ecological features of the site [9]. With the proper selection of the cover plants we can suppress dangerous weed species in the orchard system. [4] International research teams perform works on this field aiming to compose the optimal species assessment of the planted mixture for inter-row, and floor management of orchards. All of these experiments reinforce that application of the soil covering plant species results more positive effect for the orchard than disadvantages. [5]
Composition of suitable mixtures besides selection of traditionally used grass and Fabaceae species we are focusing on the involvement of local flora elements, of the experiment site, approaching a natural meadow-like association. From the local flora elements *Agrimonia eupatoria* L, *Ajuga genevensis* L, *Lotus*

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

corniculatus L, and *Achillea millefolium* L, *Anthyllis vulneraria* L, and *Medicago lupulina* L are involved. Considering that species of seed mixtures should be sown in the same time, we have started focusing on those species which have some difficulties in germination. One of these problems is hardseededness, which can happen in *Fabaceae* species, like *Anthyllis vulneraria* L and *Lotus corniculatus* L.
From experiment results of Li, and Hill [8] it is clear that hardseededness is related to seed coat impermeability in *L. corniculatus*. Differences in hardseededness between seed lots appeared not to be caused by differences in their moisture content (range 6.9-7.1 % among seed lots). The percentage of hard seeds in different seed lots showed a trend with more hard seeds being found in more mature seed lots. The authors suggest that incomplete seed coat structure in immature seed lots was often responsible for the lower percentage of hard seeds. [8]
In the case of *Anthyllis vulneraria* L [1] different heat treatment was applied resulted average 10% increase in the germination of the seeds, and decreased the hardseededness of the species by 20-40 % comparing to control. To solve seed hardiness, at least 50°C is needed.
In further literatures temperature plays an important role in breaking seed hardiness and dormancy. From the suggested methods in our experiment we have selected those which can be easier implemented by farmers and growers too, like pre-cooling, pre-chilling and scarification. [6], [3], [2]
According to MSZ 6354-3:2008 standard for seed germination test involves the pre-cooling, pre-chilling treatments of seeds, aiming to increase the germination percentage of them.

2. THE AIM OF THE EXPERIMENT

The aim of the treatments was to select those species which can be sown in the same time, will easier applied to soil and climatic conditions of the experiment site. Further aim was to test the effect of different pre-treatments on influencing germination % of seed of the tested species.

3. MATERIAL AND METHOD

Seed germination test were carried out according to MSZ 6354-3:2008 standard in climate cabinet. Seed treatments (vernalisation: pre-cooling, pre-chilling, and scarification) were carried out according to relevant standard.
Duration of incubation was different: *Anthyllis vulneraria* L was 10 days, *Lotus corniculatus* L was 12 days, *Medicago lupulina* L was 10 days, and *Agrimonia eupatoria* L was 60 days.

Methods of storage and treatments:
1. storage on 20-25°C on room temperature
2. pre-cooling on 5°C 6 weeks
3. pre-chilling on -16°C for 12 weeks
4. scarification – with sandpaper abrade the seed coat
5. pre-cooling on 5°C 6 week + scarification
6. pre-chilling on -16°C 6 week + scarification

Materials: Seed species from the Fabaceae family: *Anthyllis vulneraria* L, *Lotus corniculatus* L, *Medicago lupulina* L originated from commercial seed producers in Hungary.
Wild collected seed items of *Agrimonia eupatoria* L, *Ajuga genevensis* L, *Lotus corniculatus* L, and *Achillea millefolium* L. were also tested according to MSZ 6354-3:2008 standard.
The applied statistical method to evaluate the data of the experiment was one-way ANOVA test along with Games-Howell and Tukey post hoc tests running with IBM SPSS Statistics ver. 22.

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

4. RESULTS OF THE TREATMENTS

Germination test of *Anthyllis vulneraria* L can be followed on Fig 1. The figure shows the average number of germinated seeds according to 1, 2, 3, treatments and in relation to storage time on different temperature. Explanation of symbols on the diagrams: lower case letter indicate the significant difference of treatments inside one species according to daily evaluation: a, b, ab and ns.

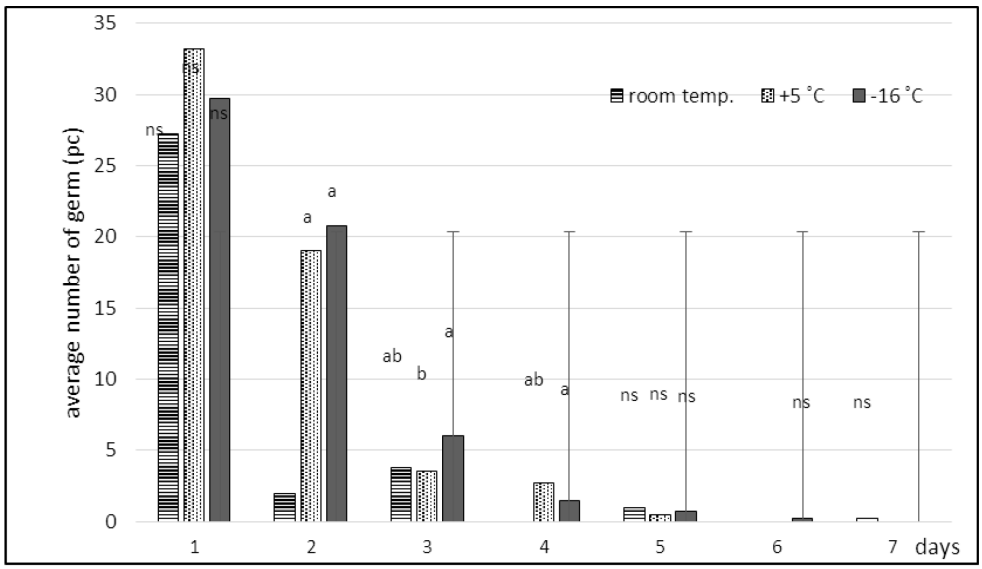

Figure 1. Anthyllis vulneraria L germination test (2016).

Germination test of *Lotus corniculatus* L can be followed on Figure 2. The diagram sows the average number of germinated seeds according to storage and treatments 1, 2, 3 on different temperature.

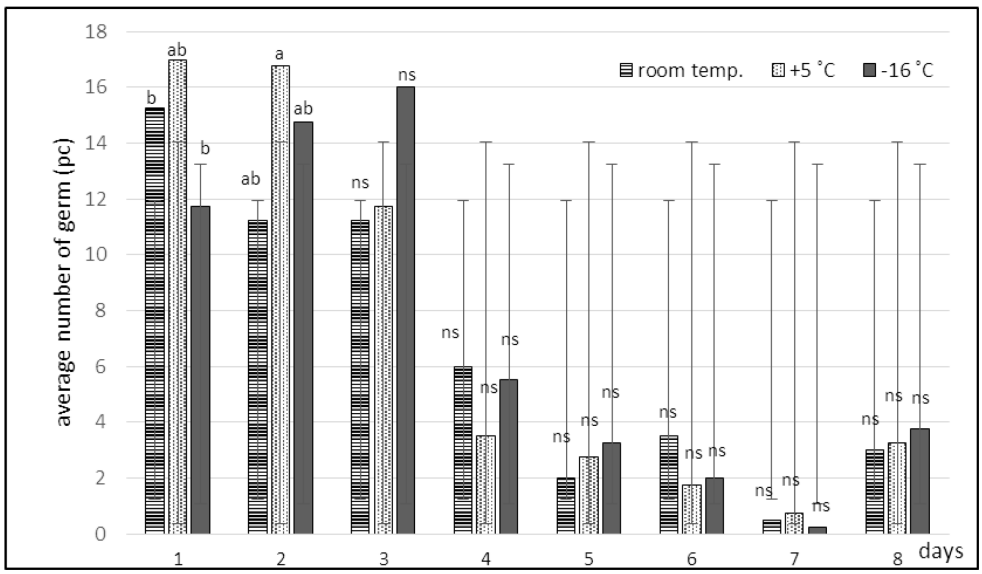

Figure 2. Lotus corniculatus L germination test (2016).

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Germination test of *Lotus corniculatus* L can be followed on Figure 3. The diagram sows the average number of germinated seeds according to storage and treatments 4, 5, 6 on different temperature.

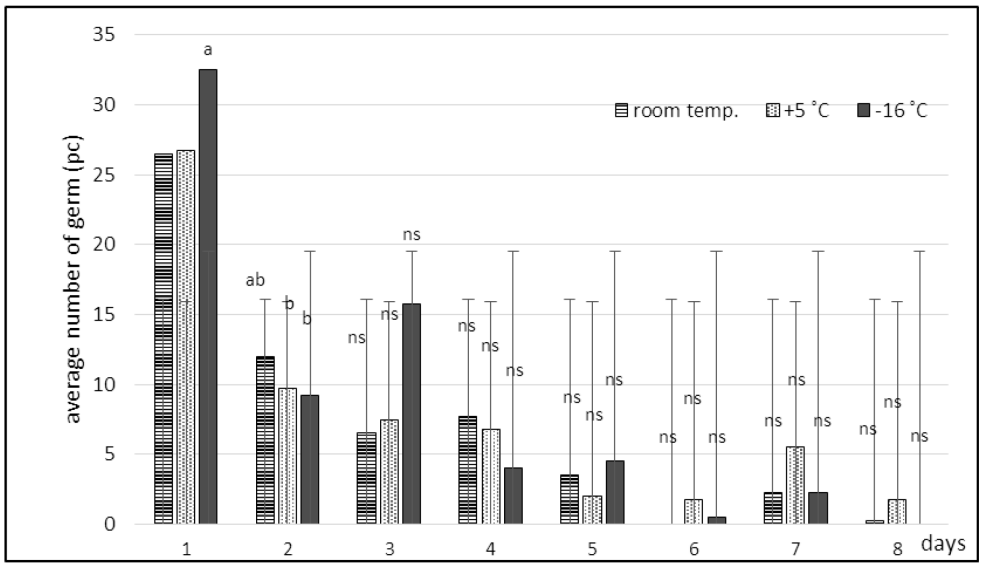

Figure 3. Lotus corniculatus L germination test – after scarification (2016).

Germination test of *Lotus corniculatus* L can be followed on Figure 3. The figure sows the average number of germinated seeds according to storage and treatments 1, 2, 3 on different temperature.

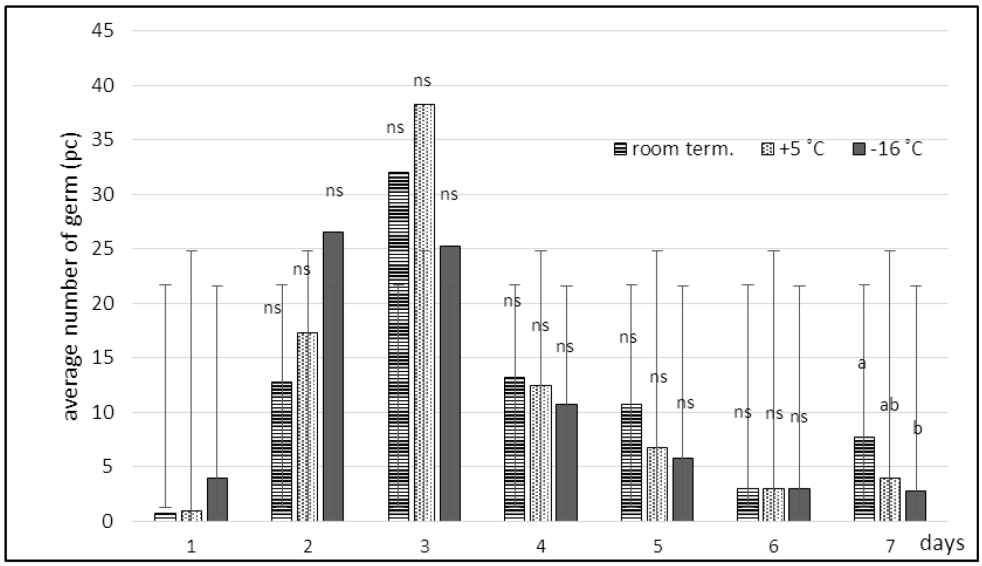

Figure 4. Medicago lupulina L germination test (2016).

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

Germination test of *Megicago lupulina* L can be followed on Figure 4. The diagram sows the average number of germinated seeds according to 1, 2, 3 storage and treatments on different temperature.

5. DISCUSSION

5.1. Reaction of species to the treatments

According to post-hoc tests, there were significant difference of the germination % according to different treatments. Considering *Anthillis vulneraria* L the effect of treatment 2. and 3. resulted significant difference comparing to treatment 1. (room temperature).
In the case of *Lotus corniculatus* L treatment 2, and 3 had significantly positive effect on germination, treatment 1. (room temperature) was partly significant.
Treatment 4. 5. and 6. had a positive effect on *Lotus corniculatus* L and the most effective treatment was the 6. pre-chilling and scarification, which significantly divided from treatment 1.
The effect of treatments 1, 2, 3 did not result a significant difference in germination data of *Medicago lupulina* L.

5.2. Effects according to treatments

Treatment 1. (20-25°C room temperature) was most effective on *Lotus corniculatus* L, *Medicago lupulina* L, and less positive effect was on *Anthyllis vulneraria*. Treatment 2. (pre-cooling on on 5°C 6 weeks) was most effective on *Medicago lupulina* L, the other two species also reacted positively but lesser extent. Treatment 3. (pre-chilling on -16°C for 12 weeks) was most effective on *Medicago lupulina* L and on *Anthyllis vulneraria* L. Treatment 4. (scarification) was applied only on *Lotus corniculatus* L resulting higher seed germination, similarly to treatment 5. (pre-cooling on 5°C 6 week + scarification). Treatment 6. (pre-chilling on -16°C 6 week + scarification), was the most effective on *Lotus corniculatus* L. significantly divided from treatment 1.

Table 1. Differences between treatments according to species (signed: lower case letter) and according to treatments (signed: upper case letter)

Species	Anthyllis vulneraria L.			Lotus corniculatus L.			Medicago lupulina L.		
Treatments	Mean	SD	Effects	Mean	SD	Effects	Mean	SD	Effects
1	34,25	5,252	bB	52,75	7,544	bA	80,25	6,994	nsA
2	59	2,582	aB	57,5	7,853	abB	81,2	8,349	nsA
3	68	6,481	aAB	57,25	5,795	abB	79	2,646	nsA
4				58,75	7,228	ab			
5				61,75	6,652	ab			
6				68,75	6,397	a			

According to data Table 1. treatments had significant effect on all of the species involved in the experiment.
Lower case letters inside the columns indicating significant difference on $p \leq 0,05$ level according to treatments. Upper case letters inside the rows indicating significant difference on $p \leq 0,05$ level according to species.

5.3. Conclusion

There are several literature suggesting pre–treatments before sowing, aiming to increase of germination % of certain Fabaceae species. The problem is species specific and different pre-treatment methods can be effective at different species. In our case *Anthyllis vulneraria* L reacted positively to pre-cooling and the best to pre-chilling treatment. *Lotus corniculatus* L reacted positively to scarification pre- treatment, in our

case the treatment 6. (pre-chilling+scarification) has the best effect on increasing seed germination %. Considering *Medicago lupulina* L there was not significant difference between the treatments on germination % of treated seeds.

Wild collected species failed to germinate according to MSZ 6354-3:2008 standard in climate cabinet in treatments 1, 2, 3. For their involvement in the experiment, alternative pre-treatment methods need to be developed.

During our research of composing species rich ground cover seed mixture it is very important to determine the germination ability of the applied species. We can conclude that some of the species like *Lotus corniculatus* L and *Anthyllis vulneraria* L need pre-treatments before sowing to reach proper germination performance and development after sowing on the experiment sites in the developed mixtures.

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Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964

Vol. 10, No. 1 2016

THE ROLE OF SALT FORM AND CONCENTRATION ON THE RHEOLOGICAL PROPERTIES OF BAKERY PRODUCTS

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ABSTRACT

The effect of different salt forms and concentrations were evaluated on the rheological properties of dough made from wheat and rye flours. Our aim was to investigate that how does the sodium chloride change the properties of gluten network and therefore the structure of bakery products and what effects can be experienced when it is substituted by other organic and inorganic salts. Different rheological tests were used to monitor the effects on dough (Farinograph, Alveograph and Extensigraph tests) and on the end-product (texture analysis, sensory analysis). It was found that all the salt forms significantly influenced the rheological parameters of dough and not the sodium chloride addition had the most favourable effect in every case.

Keywords: flours, rheological properties, firmness of bread, salts

1. INTRODUCTION

Salt (sodium chloride) is maybe the oldest raw material and additive of our foodstuffs. It gives taste or influences the taste for the product, can easily store and due its non-specific (good solubility, decreases the water activity) and specific (specific inhibition) effects on microbes it has been used as preservative for a long time. It can be found in several foodstuffs but its highest concentrations are consumed by cereal and meat products: the former one gives about 35% of total consumption and the latter one about 25% while the contribution of other food kinds are under 10% each [1].

The salt is accused of causing serious health risks: a strong connection was found between the high sodium intake and the risk of high blood pressure and cardiovascular diseases [2-4] and it was also reported that decrease in sodium intake results proportional decrease in blood pressure immediately [5]. On the other hand, sodium is essential element, it plays role in maintaining the balance of osmotic potential and acid-basin system, and in the impulse transport in the nervous system. The optimal daily intake for adults is about 5 g sodium chloride (2,4 g sodium), but the real intake is higher than this value worldwide and Hungary is one of the leaders with 17 g/day sodium chloride intake, but the consumption in Bulgaria is also outstanding with a 12 g/day value [6]. Salt intake reduction programs started worldwide to decrease the people's sodium consumption. These programs are hard to progress because of the fact that the sodium chloride also has significant role in the dough formation. Its addition influences the water absorption capacity, increases the development time and stability while making the dough more strength by the slight rise of pH, which decreases the number of positive ions and helps the formation of cross-bindings [7, 8]. On the other hand, the saltless bakery products are rejected by the consumers, therefore its decrease may make the market position of these products worse. The ionic concentrations in the dough influences the technological value of flours and the salt has important role in the formation and stability of gluten network [9-11] and these changes can be determined by different rheological methods [12-13]. Our aim was to evaluate the effect of different salt forms on the rheological properties of dough and bread made from wheat and rye flours.

2. MATERIALS AND METHODS

The evaluated flour samples were BL55 (wheat flour with 0,55% ash content) and RL60 (rye flour with 0,60% ash content). Farinograph (Brabender GmbH & Co. KG, Duisburg, Germany) and alveograph (Tripette & Renaud, Villeneuve La Garevne, France) tests were performed according to AACC approved

methods 54-21 and 54-30, respectively [14]. A Brabender extensograph was used to perform uniaxial extension on the doughs according to the AACC Standard method [15, 16].
The evaluated salt forms were sodium chloride, potassium chloride, sodium acetate, potassium acetate and calcium acetate (VWR, Belgium). Baking tests were performed by the MSZ 6369-8:1988 [17]. Hungarian Standard using Metefém 2001LMS laboratory baking oven (Metefém, Budapest, Hungary) by direct dough making method (300 g flours, 9 g fresh yeast, 6 g salt, 4.5 g sugar). Bread crumb firmness was analysed by TA.XT Plus texture analyser (Stable Micro Systems, Surrey, UK). Firmness was defined the force (expressed in kg by the software of the equipment) required to compress a 30 mm thick bread slice to 1.9 mm distance using a 36 mm cylinder probe with 36 mm diameter. The pre-test speed was 1 mm/s, the test speed was 1.7 mm/s. The firmness tests were performed 12 hours after the test baking in six repeats. All the other measurements were performed in two repeats.

3. RESULT AND DISCUSSION

3.1. Results on Farinograph water absorption and baking value

All the examined salt forms increased the baking value of wheat flour, the increasing concentrations resulted more improvement and the highest concentrations gave the highest readings. The effects of sodium salts were the lowest, the average increase was 13-14% in the average while the Ca acetate resulted 16% and the potassium salts 21-24% increase. In the case of rye the sodium chloride addition resulted a small decrease in the originally low value and the same tendencies can be observed as the effect of increasing potassium chloride and sodium acetate concentrations. The highest baking value was found by the addition of potassium acetate and the lowest by the calcium acetate (Figure 1 and 2).

3.2. Results on the alveograph and extensigraph energy values

The responses of doughs made with different salt forms were different in the resistance against tensile. On average the the alveograph energy readings required to deform the dough were much higher for wheat than for rye, but the extensigraph energy readings were higher for rye dough in several treatments. In the case of wheat flour the alveograph W value were increased by the increasing concentrations of sodium chloride (until the 4th concentration), sodium acetate and potassium acetate and also increases were experienced in the case of rye dough using potassium chloride and sodium acetate, but the use of sodium chloride resulted weaker rye dough (Figure 3).
The extensigraph energy values were similar for wheat and rye dough, only in some cases were experienced projecting values for wheat dough (the use of 6g sodium chloride, potassium chloride and potassium acetate) while the readings for rye flour seem to be unmodified by salt forms and concentrations (Figure 4).

3.3. Results on test baking

In the case of the evaluation of test breads significant differences were found for rye and wheat breads. The crumb firmness values were much higher for rye breads; the average value was 2,0 kg in the case of wheat breads and 9,3 kg for rye breads one day after baking. In the case of fresh wheat bread harder crumb was experienced when sodium and potassium chlorides were used, but no clear tendencies can be found in the readings of rye bread. Repeating the measurement 3 days after baking 50 and 100% higher values were experienced. Addition of sodium acetate and the first concentration of potassium acetate resulted lower aging for the wheat bread, but in the case of rye bread 2% sodium chloride, 1% sodium acetate and 2% calcium acetate resulted moderate crumb hardening during storage (Figure 5 and 6).
The taste of breads were significantly influenced by the salt forms. The bread made without salt was tasteless and its crumb was slightly coloured. The addition of sodium chloride resulted the usual taste but it

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

was not typical in the case of 1% addition. The taste of potassium chloride is found to be metallic by references; it was experienced in the 2% addition but the lower concentration resulted slightly salty taste. The acetates resulted dense crumb. The sodium acetate gave insipid taste, but the aftertaste was pleasant and these breads have typical crunchy crust. The taste of breads made with potassium acetate were characterless but their crusts were crispy. The calcium acetate gave sweet taste to the crumbs of breads, especially in 1% concentration but their crusts were tasteless again.

4. CONCLUSIONS

It was found that all the salt forms significantly influenced the rheological parameters of dough and not the sodium chloride addition had the most favourable effect in every case. On the other hand, the taste of sodium chloride seems hard to be substitued by other salt forms.

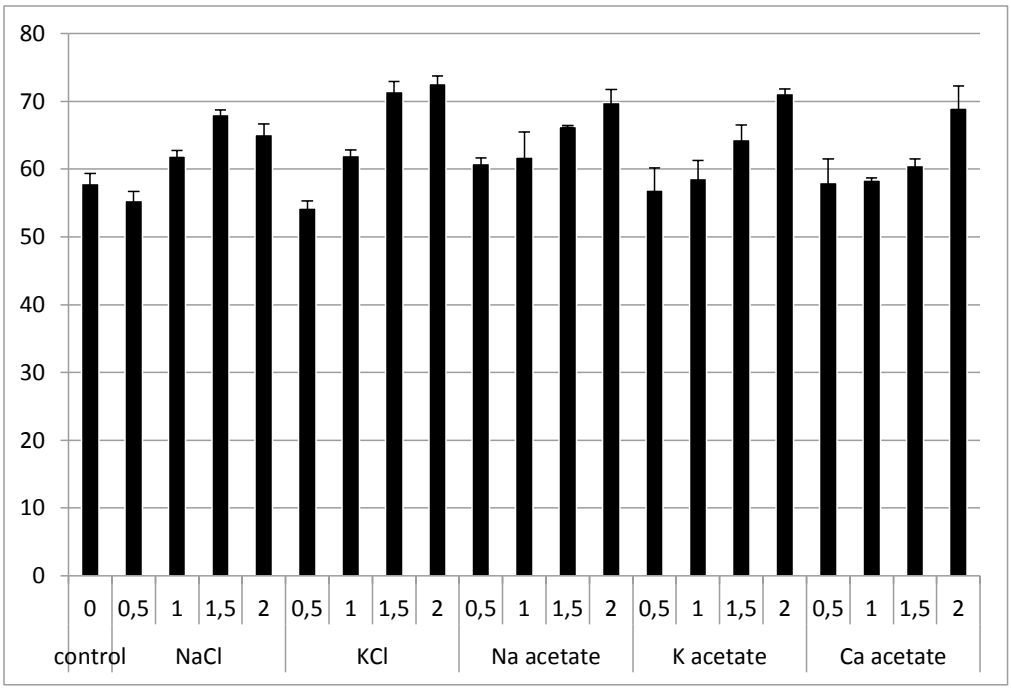

Figure 1. Effects of salt forms and concentrations on the baking value of BL55 flour

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

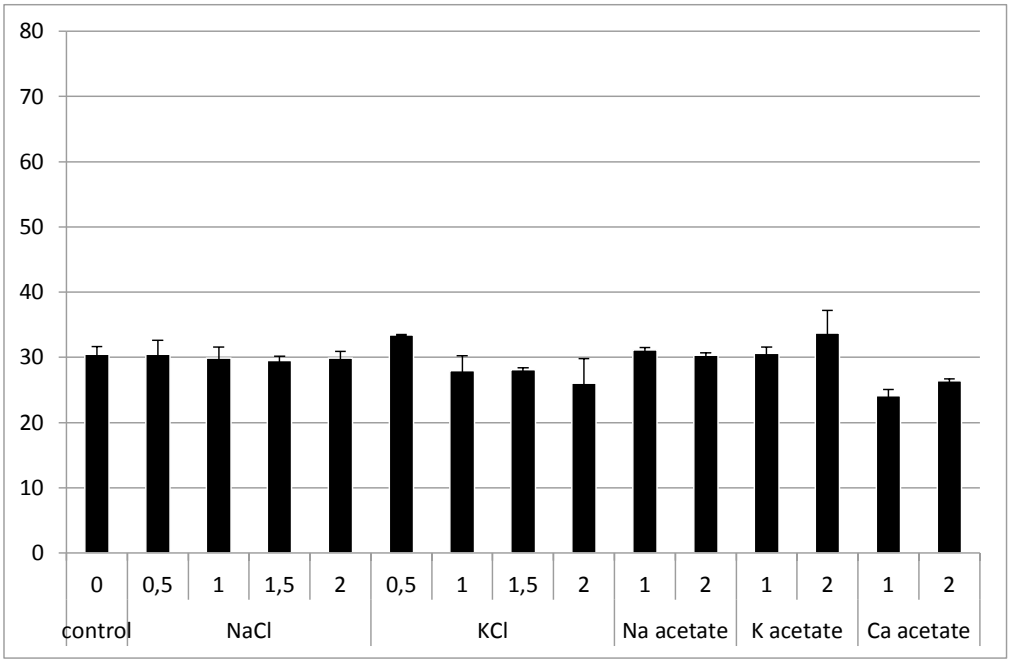

Figure 2. Effects of salt forms and concentrations on the baking value of RL60 flour

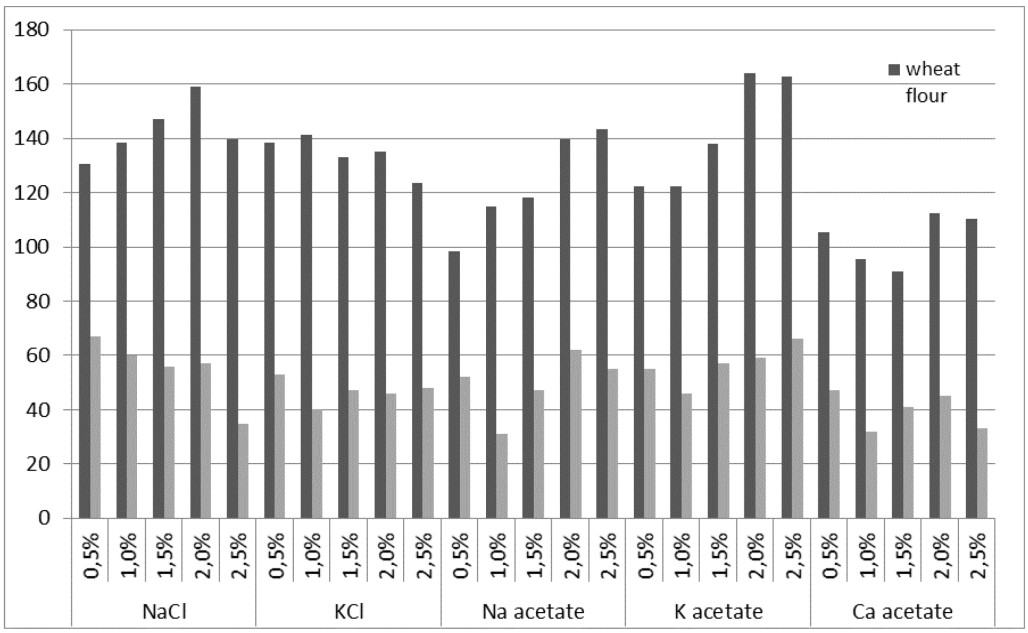

Figure 3. Effects of salt forms and concentrations on the alveograph energy of BL55 and RL60 flours (10^{-4} J)

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

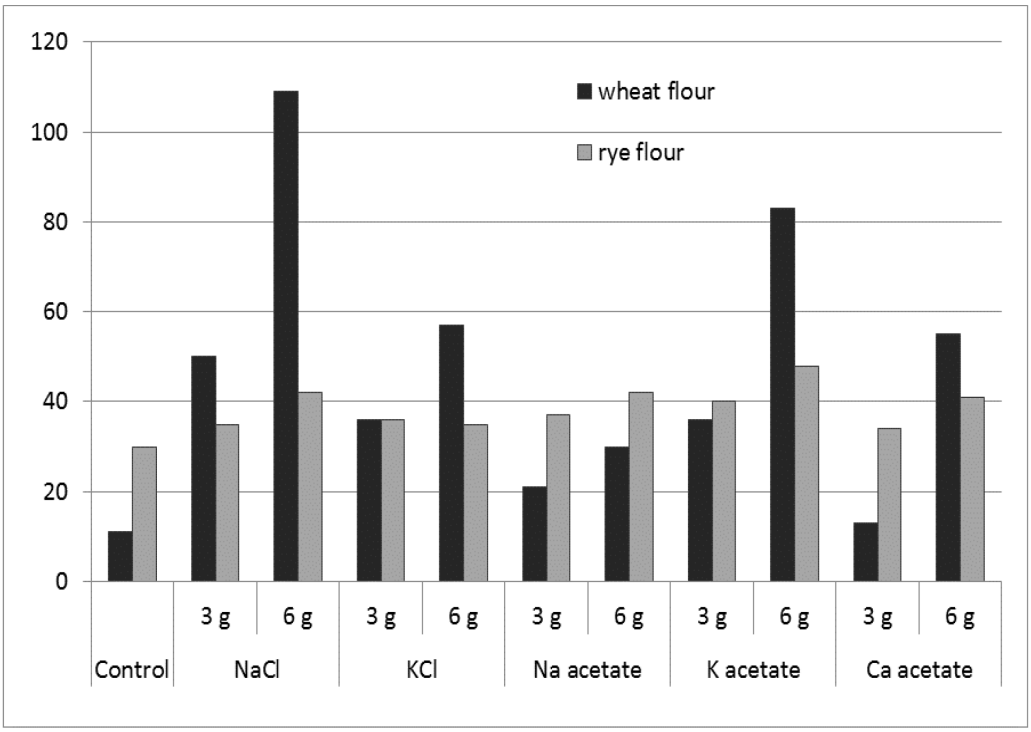

Figure 4. Effects of salt forms and concentrations on the extensigraph energy of flours (cm^2)

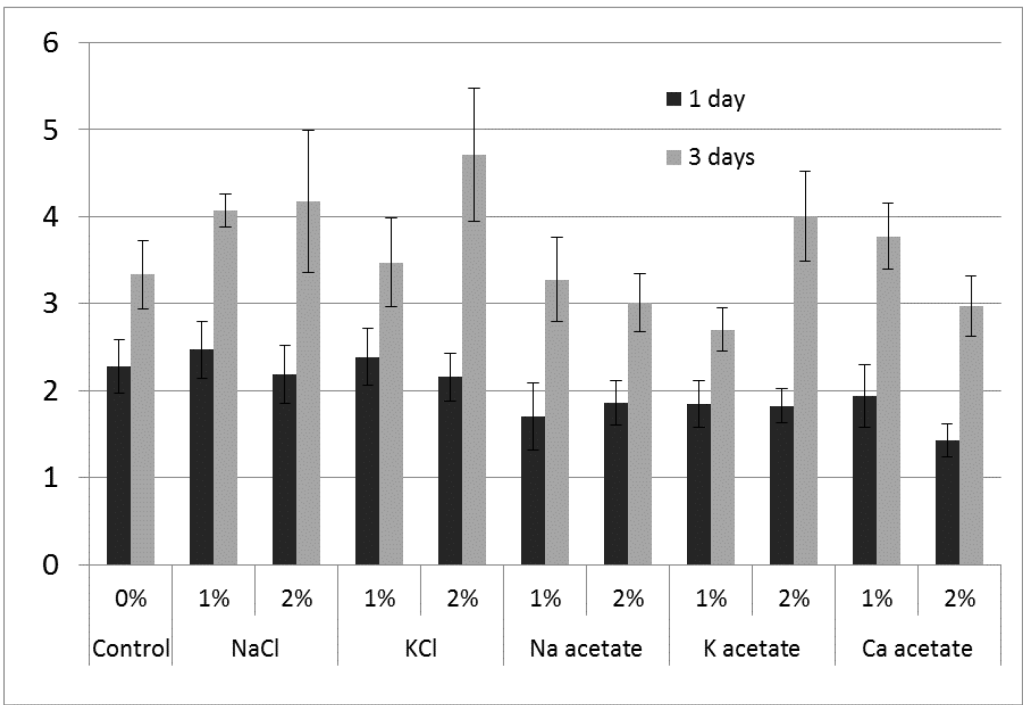

Figure 5. Effects of salt forms and concentrations on the firmness of wheat bread crumb (kg)

Analecta
REVIEW OF FACULTY OF ENGINEERING
Analecta Technica Szegedinensia
ISSN 2064-7964
Vol. 10, No. 1 2016

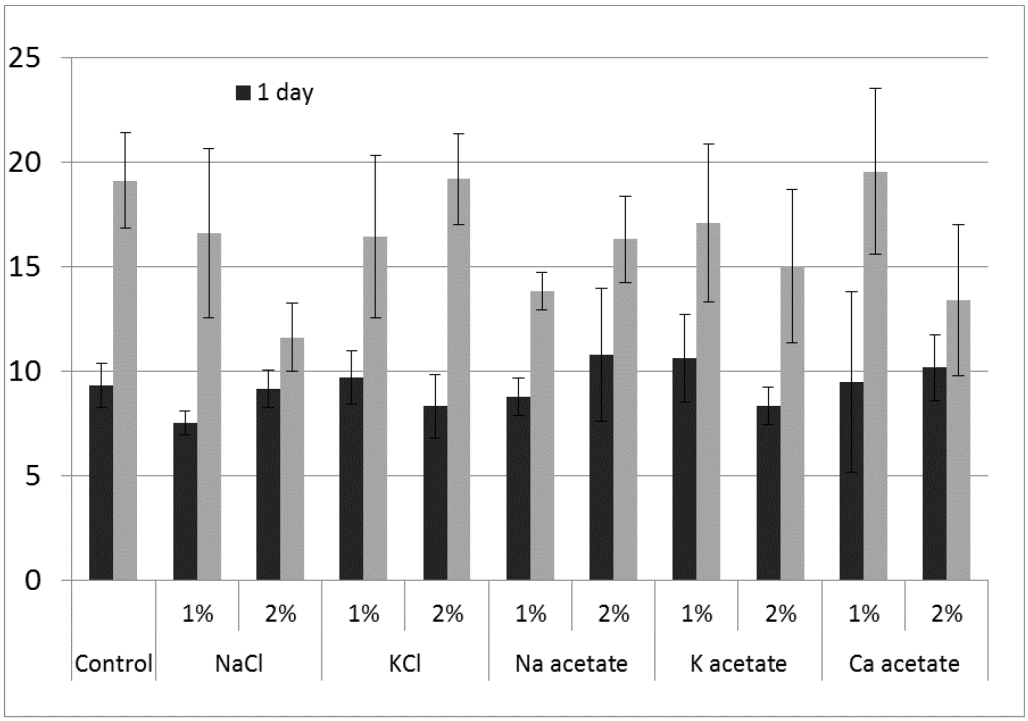

Figure 6. Effects of salt forms and concentrations on the firmness of rye bread crumb (kg)

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Analecta
REVIEW OF FACULTY OF ENGINEERING
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USING OF BIOETHANOL FUELS IN IC ENGINE

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ABSTRACT

Renewables - excluding large hydro accounted for 48% - increased to 15.2% of world cumulative generation capacity in 2014, from 13.8% in 2013. In the EU, the European Parliament approved a reform of the 2020 biofuels target. The new version of the Renewable Energy Directive (RED) distributes the 10% cal. biofuels target into a share for crop-based biofuel (limited at 7% cal.) with the rest to be met with another biofuels and renewable electricity containing multiple counting possibilities.[7] Merely 2% of the EU's fuel consumption can be covered by its own researches, which looks good pretend a strong dependence on the oil exporting countries. The implementations of biogenic fuels produced from fast growing plant is continuously gaining in importance with regard to economic and environmental effects. Generally they are not offered in their pure form but just as blend components to conventional fuels. [1][3][4] Their mixtures can bring about fundamental feature improvements.[2][5][6] Ethanol fuel output in 2015 reached a peak high helped by rising gasoline demand in the US. Besides, the changes in the fuel taxation in Brazil and an increase in the minimum blending ratio also pushed along the ethanol fuel demand. The weaker euro and low grain prices on the back of a record wheat crop turned into a considerable growth in output in the EU. Disregard the stimulating developments on the legislative side, it must also be confessed that the decreasing crude oil prices took their customs on the 2015 biofuel markets. For ethanol fuel, more growth could theoretically arrive from an extending of E-10 in EU member states. Unnecessary to discuss that an outlook for a post-2020 biofuels target at the EU level does not valid [8][9].

Keywords: renewable energies, biofuel target, blending ratio, ethanol fuel demand.

1. INTRODUCTION

In order to implement the objectives of research task the comparative analysis were made with two different manufacturer's bioethanol fuels (AGIP-E85, OIL-E85) in the engine testing brake. The measuring apparatus contains– a Honda GX 160 type (one cylinder, 4-stroke) gasoline engine, equipped with Energotest-MMP-4 type electric-brake and a computer based control and evaluating system connected to it.

2. MATERIALS AND METHODS

The test was based on three short-term runs operated with commercial gasoline (reference) and two different bioethanol fuels with the aim to compare the internal combustion engine behaviours by unchanged settings.

The engine test was made according to directives of ECE 24 standard, so the engine was fitted with the original intake and exhausting systems and these drove the moving parts. The measurements were made in 23 operating points between 1400 rpm and 3600 rpm. The values of torque (M) and the effective power (P_{eff}) were measured in case of full throttle and fixed dispenser lever position in every operating point. After selecting a given operating point the control of the measurement, together with the collection and the evaluation of the data are completely automated. (Energopower Software by Energotest Ltd.)

Analecta
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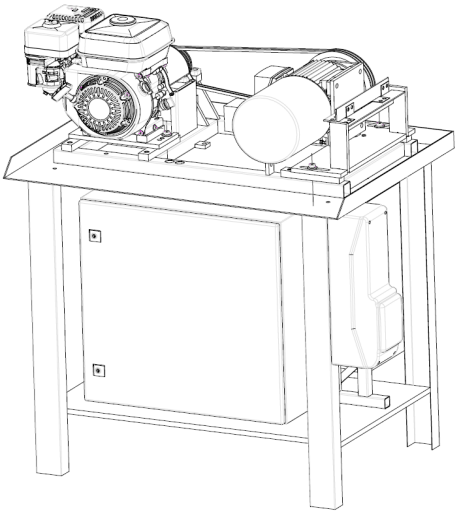

Figure 1" MMP-4 „Electric brake"

3. RESULTS

Deviations in the combustion behaviour and the functions of the engine control unit are quantifiable at the test bench. For the two bioethanol (E-85) fuels tested their torque and effective power parameters were more less than the reference E-95 values. Diagram 1 shows the relations between torque and revolution and the 2-nd one describes connections between effective power and rpm.
We established more less values in case of both parameters (less, than 50%), which can explain with lower calorific value (26.7MJ/kg) and stoichiometric ratio (8.97) of bioethanols oppposite gasoline' same parameters (43MJ/kg and 14.7).

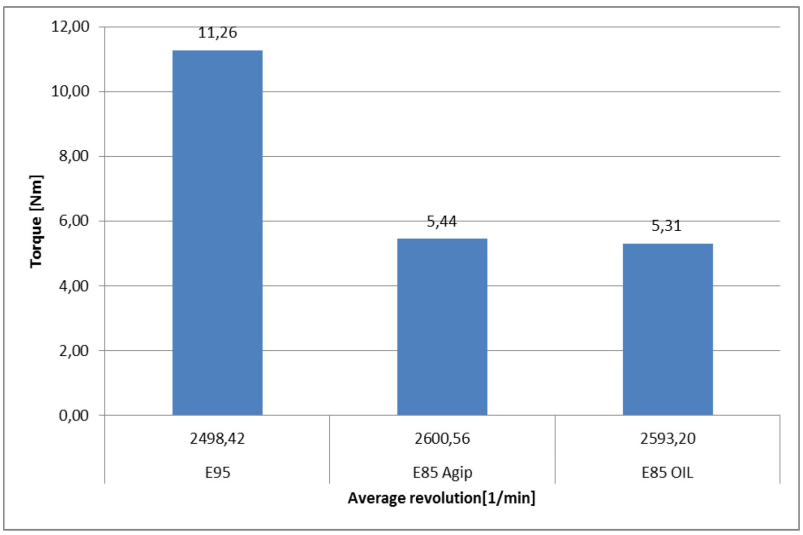

Figure 1. Relations between torque and revolution

Analecta
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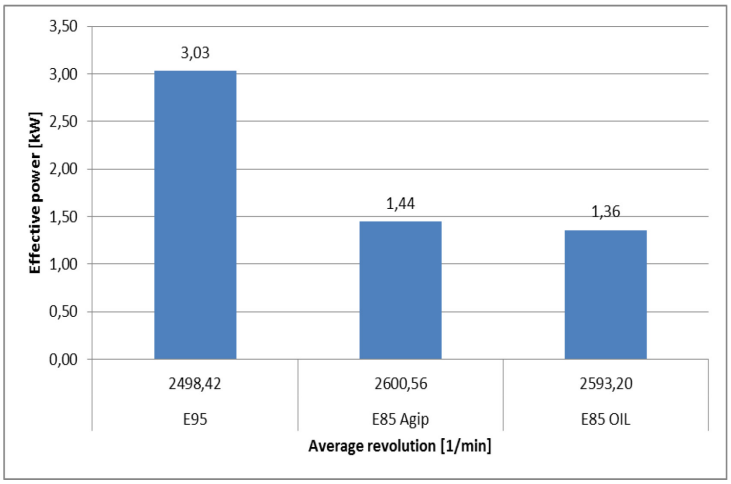

Figure 2. Connections between effective power and rpm.

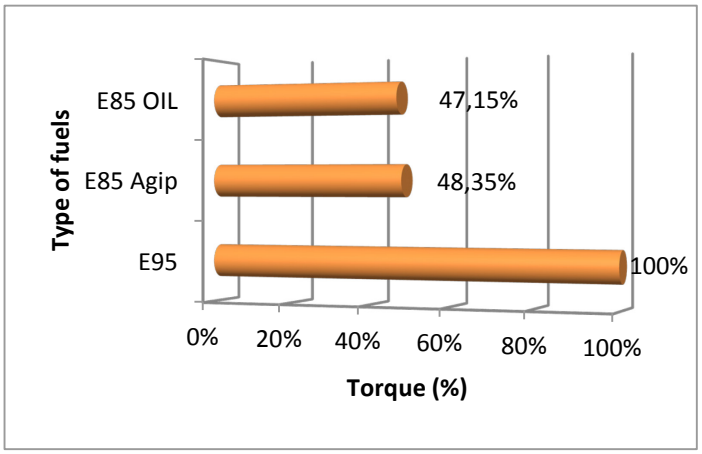

Figure 3. Changes between torque and fuel types

Analecta
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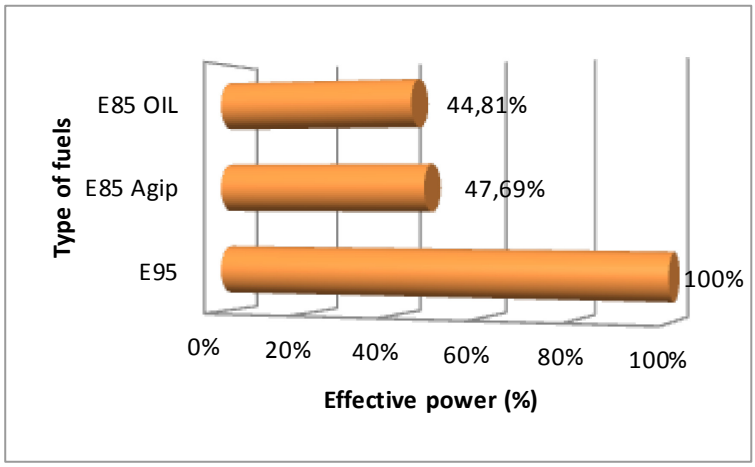

Figure 4. Changes between effective power and fuel types

4. DISCUSSION

For this project two different manufacturer's bioethanol fuels were assessed with regard to their combustion behaviours by unchanged settings. The tests were carried out at a Honda GX 160 engine equipped electric brake. We determined that large-scale deviations of calorific value and stoichiometric ratio caused the explored very smaller torque and effective power values (less, than 50%) in case of bioethanols.
Certainly by engine settings changes (e.g. ignition timing adjustment, increasing compression ratio, spark plug) we can further improved behaviour of our engine.

5. CONCLUSIONS

Our three short-term tests were operated with commercial gasoline and two different bioethanol fuels (AGIP-E85, OIL-E85) with the aim to compare the IC engine behaviours by unchanged settings. We'd recognised more less, than 50% values in case of torque and effective power, which can explain with lower calorific value (26.7MJ/kg) and stoichiometric ratio (8.97) of bioethanols.
We would like to continue our examinations testing several blending bioethanol fuels for further percentage distribution.

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